METALS and ALLOYS

The Engineering Magazine of the Metal Industries

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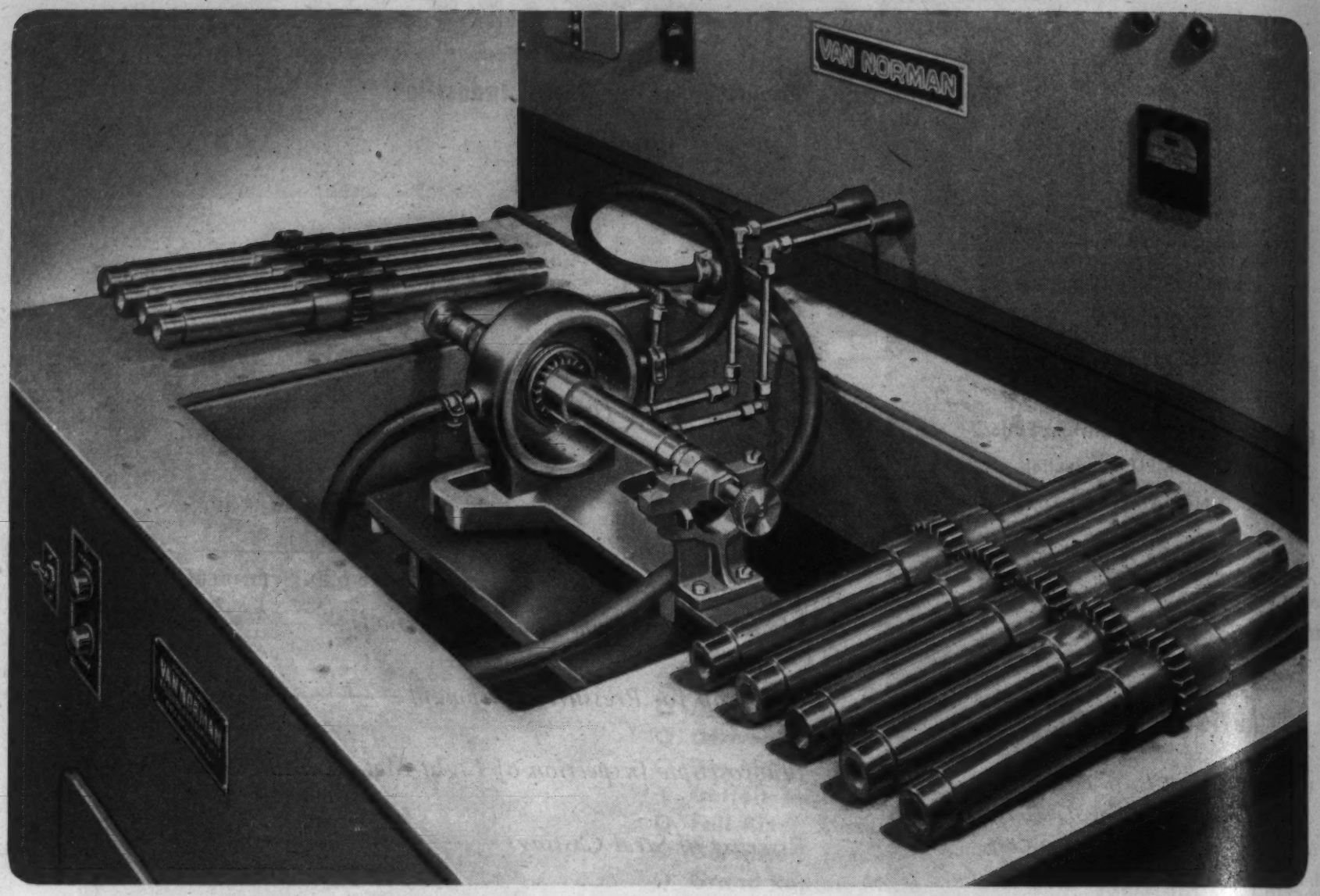


VAN NORMAN

HARDENS GEAR MADE INTEGRAL WITH SHAFT IN 16 SECONDS WITH NO DISTORTION OF SHAFT!

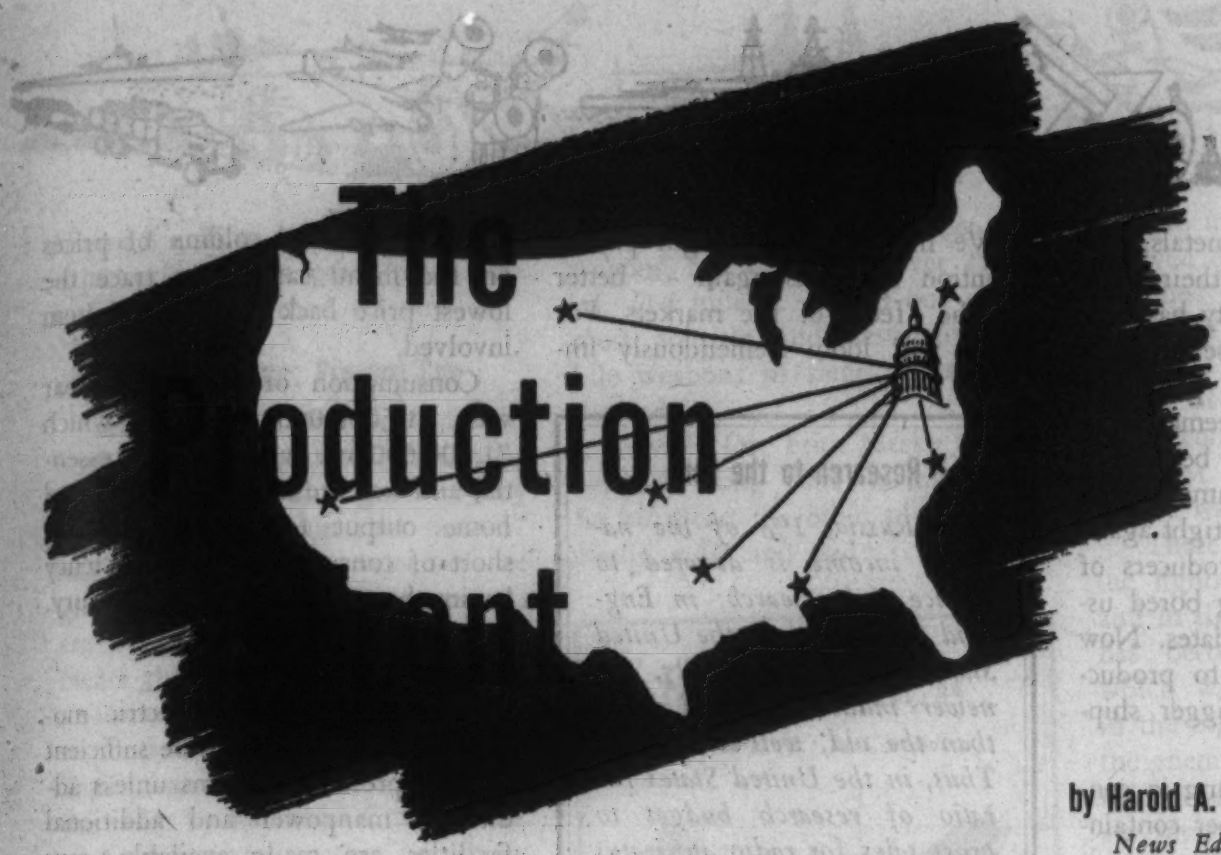
Because the Van Norman Induct-O localizes heat in a particular section of a part, it permits surface hardening of individual sections of shafts, cams, etc. without affecting the rest of the workpiece.

For example, the teeth of the $2\frac{1}{2}''$ diameter gear made integral with the shaft, illustrated, is hardened to 55 Rockwell C in 16 seconds. The heating time is 10 seconds followed by a 6 second quench.

With the previous heating method, the entire part was heated for hardening the teeth with the result that warpage and distortion of the shaft was often encountered. This called for a costly, troublesome straightening operation. The Van Norman Induct-O, however, localizes heat in the gear teeth only, thus no warpage takes place and the usual straightening operation is eliminated. Obviously Van Normanizing speeds production, cuts costs and reduces work spoilage. If your production calls for hardening, brazing, soldering, annealing, forging or melting, it will pay you to investigate the Van Norman Induct-O high frequency induction heating unit. Write for fully descriptive catalog.

"It pays to Van Normanize"

VAN NORMAN COMPANY
ELECTRONICS DIVISION
SPRINGFIELD 7, MASSACHUSETTS



The oduction nt

by Harold A. Knight
News Editor

Hitler is like litmus paper, indicating whether our war production and use thereof is sweet or sour. . . . Remember when he danced the jig at the fall of France? . . . Remember when his beautiful friendship with Benito became shopworn? . . . And his promises to the German people in 1939, and now? . . . Some metals have stable economic status, but others are like pendulums.

More price reductions remind us that some day prices must really be reckoned with. . . . Small electric motors and steel forgings are stress points. . . . Five-magnesium plants ordered to cut output. . . . Areas of acute labor shortages increase. . . . Shall we reward the war plant worker who sticks to his job? . . . German guns in Italy better than ours, outranging ours? Cartoon: the modern magic carpet. . . . Can we play the cartel game? . . . We correct an erroneous implication about lead. . . . Practical "imagineering." . . . Research is on the throne. . . . We're shooting away our steel.

Hitler, In Person, a Weathervane

One does not need to study maps, read news reports or listen to the news events via radio to ascertain accurately the drift of the war.

We recall a warm September day in 1939 when we were relaxing on the screened porch of our home in Westchester. The radio was turned on and suddenly the announcer interrupted: "We are tuning in on the speech of Adolf Hitler at Munich." Then poured forth a torrent of guttural cacophony of sound, pitching higher and higher, and punctuated by the artificial heils of the good Nazi party members.

It all seemed out of harmony with the zinnias, marigolds and crysanthemums in our field of vision.

Yes, we don't need to study maps — just follow Hitler closely through his less frequent speeches, and moving pictures and newspaper accounts of the man. Then came the time when France fell.

The news-reels pictured Hitler at the front, surrounded by his generals, when he first heard the news. The camera caught him doing a little dance-jig of exuberance — a dance step which resembled the "Irish Washerwoman" jig along with what Arthur Murray might call an illegitimate rhumba step.

Hitler's leather boots sparkled with polish in the bright sunshine. His uniform fit perfectly. The stiff German generals broke into smiles. This was the P (peak)-Day in the 52-year old career of Schicklgruber.

Sand Trickles Through Hour Glass

Then the hour glass started running out, though imperceptible at first. Let's skip to the day that Benito Mussolini, after Italy's fall, landed in Germany in civilian clothes, greeted by Hitler.

What had become of the polish on Hitler's boots? What meant those haggard creases in Hitler's face; the pouches under his eyes; the "5 o'clock shadow" on his cheeks and jowls?

Do you news photographers mean to tell us that that bum who disembarked from the plane was the Great Thunderer, Mussolini?

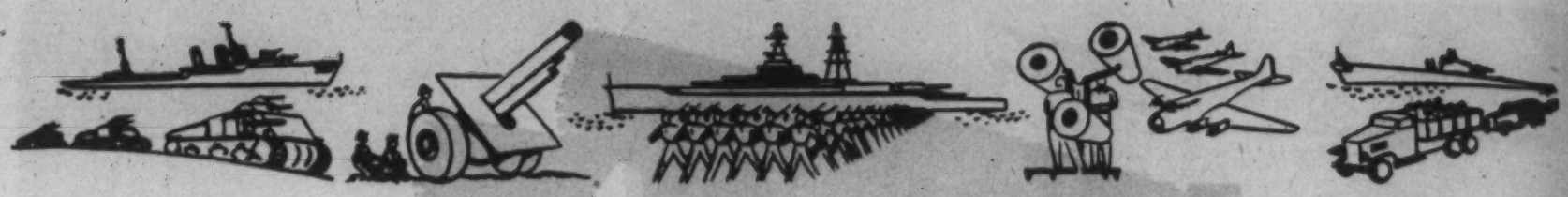
And what did Hitler promise his people back in 1939? What does he promise now? Can this be the same man?

These reflections are appropriate here only because they measure in results what American and other United Nations war production has accomplished. The sand in the hour glass is running out — it is fairly cascading out!

Copper is a "Pendulum" Metal

In this great Land of Plenty, where we used to kill off the pigs and plow under the corn, we are still compelled to count and recount closely our assets, whether rationed food or priority metals.

Month after month the description of the supply situation in these columns may get monotonous, yet abundance of basic materials and components is the first prerequisite to war production, and cannot be ignored.



In the case of several metals, such as lead, nickel and tin, their status as to abundance or scarcity has been consistent, but in the case of many they have experienced pendulum swings. Copper, which seemed overabundant at mid-February because of the cut in small arms ammunition manufacture, has become tight again.

A few months ago producers of ingot copper were urging bored users to specify shipping dates. Now the users are clamoring to producers for prompter and bigger shipments.

The pendulum has swung in containers. To save tin, paper containers were employed. Now paper is scarce and very critical.

However, the over-all picture in metal supply is good. There is not the anxiety that prevailed early in the war. Some of the predicted shortages were fantastically diverse from the actual situation finally encountered.

The pendulum swings toward scarcity on chromium because the bulk of ore comes from Rhodesia, where overworked railroads concentrate on coal haulage.

The antimony stockpile here is 27,000 tons in ore and metal, perhaps ample. There is a great abundance in Mexico, but not in railroad facilities to bring it to the Texas smelter. Ferrotungsten is so abundant that prices are being cut.

We Must Get Price Conscious Again

Speaking of prices, indium was recently cut to $7.50 per troy ounce for the commercial grade. A reduction of three cents per lb. in the base price of polystyrene molding powders was announced by Dow Chemical Co., giving a trend indication of plastic materials.

An embarrassing price situation had beset producers of brass ingots, where copper and tin are chief ingredients. The correct grades of copper and tin-bearing scrap are extremely scarce, hence makers buy virgin metals, paying naturally higher prices. However, as we go to press, brass and bronze ingot ceiling prices have been raised.

We might as well begin paying attention to prices again — better get the "feel" of the markets. For prices will loom tremendously important in the competing days just around some more or less near corner. Days will come when the design engineer will be like the Scotsman in the restaurant — look first at the right hand column of prices on the menu card, then trace the lowest price back to the food item involved.

Research to the Fore

In Russia, 1% of the national income is devoted to science and research; in England 0.1%, and in the United States 0.3%. Generally, the newer industries spend more than the old, well-established. Thus, in the United States the ratio of research budget to gross sales for radio apparatus is 1.6%; for electrical communication, 1.4%; and for chemical industry and rubber products, 1%. So states Sir Harold Hartley, F.R.S., vice president, London, Midland & Scottish Railway Co.

Research has enjoyed a new birth, and in the post-war world will have more prestige than ever before. It will be mainly in two divisions: (1) Products design, in which the engineers will be concerned; and (2) markets development, in which the sales managers will lead.

This mechanical - electrical war has meant survival for the most advanced technicians. The bank clerk has learned electronics in the signal corps; the housewife has mastered welding at the gun plant. Few are they who have not been exposed to war techniques and sensed the importance of science.

Research means better technique, and research and technique mean advancement, as never before. And the world will advance fast to offset these terrible, Dark Ages years!

Consumption of silver last year was 118,000,000 oz., of which 71,000,000 oz. were used by essential and war industries. Imports and home output fell 15,000,000 oz. short of consumption, the deficiency having been loaned by the Treasury.

Motors and Forgings Critical

Production of small electric motors for aircraft will not be sufficient to meet present programs unless additional manpower and additional facilities are made available, says WPB. Steel forgings are a touchy factor because of substantial increases in aircraft, landing craft, army truck and farm equipment programs. Aircraft forging requirements alone will be 35% higher in 1944.

There are, indeed, many evidences of plenty. At mid-March WPB ordered reductions in production at five magnesium plants, thus cutting output 34,000,000 lb. per yr., or less than 6% of the country's capacity.

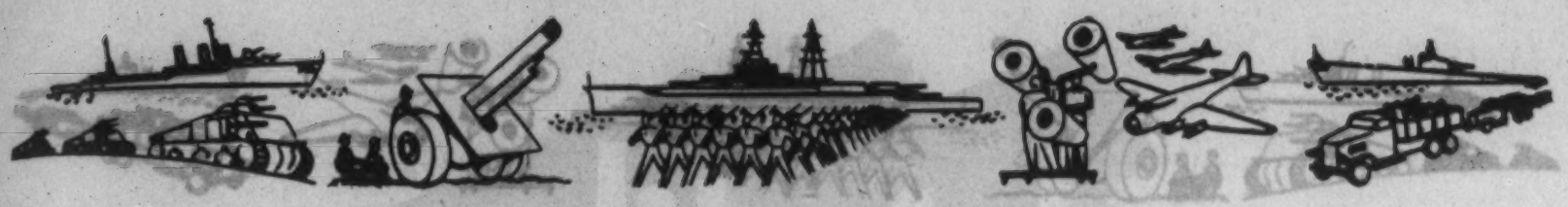
Manpower May Be Reshuffled

Manpower is still the No. 1 problem that engages Washington, from the President down. Areas of acute labor shortages increased from 68, as of Feb. 1, to 72 on March 1.

A region-wide campaign has begun to persuade 300,000 men and women in the District of Columbia, Maryland, Virginia, West Virginia and North Carolina to leave their communities and take war jobs in other sections more active in war production.

One problem that bothers the War Manpower Commission is the tendency for war plant workers to seek peacetime employment to get in on the ground floor. Every time a favorable war development takes place, there is an exodus, workers believing that the war is nearly over.

WMC is considering the plan of dismissal pay and high post-war job priorities. Thus, a worker, faithful to the end in the war plant, would



receive a sum to tide him over and a job priority in a peace plant, second only to returned veterans.

American Guns: Pro and Con

German guns in the Anzio beachhead area of Italy are in some ways superior to American guns. They have a 170-mm. gun that fires 17 miles. Their muzzle velocities are greater than ours. Their mortars are superior, and in other departments they are better.

Thus wrote C. L. Sulzberger, correspondent of the "New York Times," and reported that night over the radio by Raymond Gram Swing, who often gives a rather pessimistic tinge to his interpretations. (A year ago, for instance, he was most bitter and discouraging about the submarine menace.)

Our only hope in Italy is to outgun the Germans by mere weight and numbers, supplementing ground work by aircraft, continued the commentators. Yet, it is too bad, because the Germans can reach our gunners, but we can't reach them.

A bit disturbed, we wrote to Major-General Levin H. Campbell, Jr., Chief of Ordnance. He did not answer our questions directly, but sent us data about three of our own mobile guns. From these data we learn that one of these guns shoots 20 miles. Perhaps the logical question is: "Is this gun in Italy?"

At any rate, here are some facts concerning our three most popular mobile guns. Our "Long Tom" is a 155-mm. gun on a high speed carriage, with overall weight of 30,000 lb., range of over 25,000 yd. (14 miles), firing one round per min., with muzzle velocity of 2800 ft.-sec.

It has a split-trail carriage, and can be towed at the speed of a truck. Its accuracy is so deadly that it is actually accredited with sharpshooting in Italy.

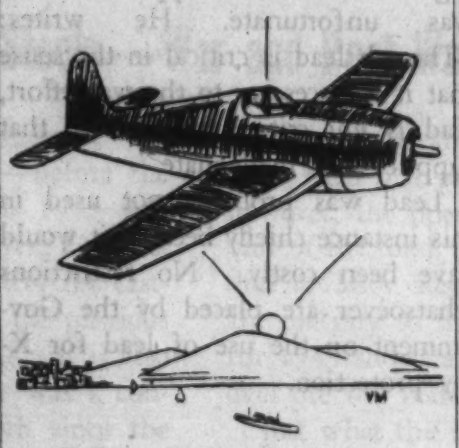
Our 8-in., or 200-mm. gun, described as "a honey" by Maj.-Gen. Campbell, fires a round a min. to a range of 35,000 yd. (20 miles), with a muzzle velocity of 2600 ft.-sec. Total weight is 69,000 lb.

The 240-mm. howitzer, traveling in two sections on rubber-tired wagons, has a range of over 25,000 yd. (14 miles). "It is one of the most accurate and destructive mobile weapons of siege warfare ever devised."

Possibly Dr. Fritz Meske of Berlin had "Long Tom" in mind when he broadcast the other night on the Berlin radio and said:

The Magic Carpet of '44

by V. M. McConnell



Magnesium
and aluminum —
The flying metals these.
Using nickel
And tin
To keep horsepower in,
And steel
And manganese.
With "Vitallium"
For the supercharge,
At eight miles up
Or more,
Oh, it's safe
And snug
In the magical rug
Of 1944.

"The enemy's strength lies in his extremely extensive and variegated artillery. Whole batteries fire on every individual soldier or dispatch rider who shows himself, so that attacks and troop movements can hardly be made at all, except at night.

"Enemy artillery, often supported by heavy naval guns, covers with drum fire of world war dimensions every bit of the ground where the German main line is either found or believed to be.

"The whole district around Aprilia is covered by a milky smoke of shells. It is a hellish test for the nerves of the Grenadiers. Our advance continues over the graves of our dear comrades in the fifth year of the war, as it did in the first.

"There can be no question that the fighting, on the southern front and in the Nettuno beachhead alike, has become harder to an extent which we have hardly experienced in the big battles in the East. What the enemy cannot reach with his artillery, he attacks with his very strong air force."

To quote Andre Maurois, in "Life" magazine, an anonymous captured German general said: "If I had to organize an international army, I would choose German infantry, French artillery, British aviation, Italian music and American ordnance."

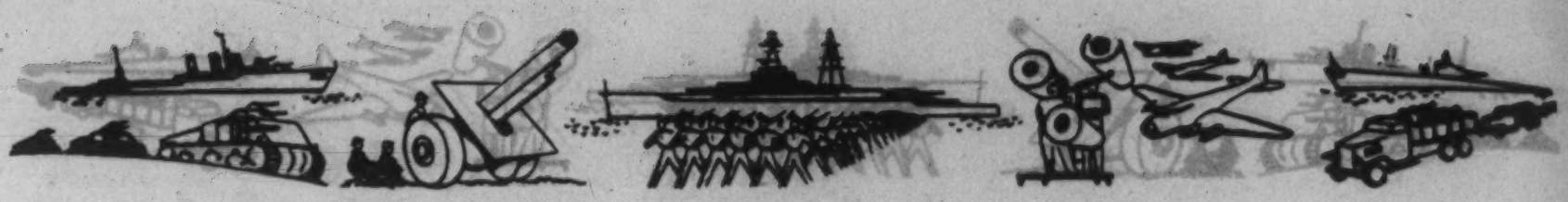
Cartels—Or the Natural Way?

One of the main post-war problems will be to what extent our Government shall countenance cartels. As the world grows smaller and individual nations tend to lose their identity, the cartel issue will loom larger.

If we are joining cartels we are going up against the "city slickers." The United States has shown itself a Mortimer Snerd in European power politics, dominated by smart Charlie McCarthys.

Moreover, in prewar cartels our companies have often been in the position of the freshman who was taken "snipe hunting" by the sophomores. On a dark foggy night the freshman is taken to a lonely wasteland and instructed to hold open the burlap bag while the sophomores drive in the snipe. It has come to light a great deal of late that our companies were "left holding the bag" during the past decade.

About 12 years ago cartel joining in our metals industry was in its hey-day. There was a legal loophole in the Clayton Act, whereby Americans could set prices for export, whereas it was illegal to conspire on prices in the home market.



For years copper producers combined with foreign producers to maintain prices in the foreign field on copper. It may have been this artificiality that caused the disastrous break in copper prices from 18 down to 5 cents per lb. some dozen years ago.

Our tin plate producers joined a cartel where territory was divided up. Several of our steel producers entered such a cartel on rails, in particular, and many other products. On rails the producers had their best argument. Rail consumption is naturally limited, as John Q. Public does not buy rails to lay in his backyard.

Though there has always been much hush-hush about these cartel participations, the impression is that the Americans were rather clumsy boys. The Germans are said to have been the smartest, and the English horse traders did not do badly for themselves.

In the long run, it is probable that American manufacturers were more often hurt than helped by cartels. After all, Americans have the raw materials, the mass production methods and skilled labor to more than hold their own under natural conditions of doing business. When they get involved with the sharks, they are apt to come out second best.

So, in short, if the United States is again going to participate in cartels it is best that we get hard boiled and sophisticated. The European countries have played this game longer than we. The United States is bound to take some lickings at first. We must weigh, too, the theory of survival of the fittest in competition (and aren't we fittest?) as against joining the high-power boys who have tricks up amply-cut sleeves.

Lead is by No Means "Critical"

In the "Digest" section of the February 1944 issue of METALS AND ALLOYS, page 460, appeared a condensation of an original article on "Earth-Filled Walls for X-ray Building." The significant facts published were that for a new research laboratory at Ohio State University, thick earth-filled concrete-block walls are used to shield operators of X-ray equipment and the public, instead of the thick layers of lead used normally.

The digest concludes: "Lead lining of the rooms would have had to be 12 in. thick, which would have meant that several tons of critical material would have been required."

We are in receipt of a letter from Robert L. Ziegfeld, assistant secretary, Lead Industries Assn., suggesting that "critical," as applied to lead, was unfortunate. He writes: "Though lead is critical in the sense that it is necessary to the war effort, lead is *not* critical material in that supplies are inadequate."

Lead was probably not used in this instance chiefly because it would have been costly. No restrictions whatsoever are placed by the Government on the use of lead for X-ray protection.

Engineering Imagination—Hail!

It is said that opposites often attract each other. The timid are attracted by the brave, and the brilliant man often marries some silly little girl. We recall a clock in our living room with two winding sockets — one to wind the time mechanism; the other, the strike. Unfortunately, the clock struck during sleeping hours as well as daytime.

We decided to stop the strike altogether. So, with screwdriver and tweezers we attempted to remedy it by taking off the hammer and coiled anvil. Sweat was on our forehead, our knuckles were bruised and our vocabulary was questionable, when our then seven-year old son came into the room. On his placid forehead creased a frown. Unable to contain himself any longer, he suggested: "Dad, why don't you simply not wind the strike?"

Convinced right then and there that we have no engineering imagination, we set out to admire with awe those who do have. Two incidents have come to our attention during the past month to whet our admiration.

Unpainted Flying Fortresses are now coming off assembly lines of Boeing No. 2 plant at Seattle. They are lighter by 60 lb., and faster by several miles an hr. The only paint is black patches on surfaces that would reflect sunlight in airmen's eyes. Elimination of the camouflage paint contributes further to the low man-hour production rate.

The second anecdote is contributed by the American Iron & Steel Institute. At one iron mine in the Adirondacks, ice has accumulated through the years in the open mouths of old workings — hundreds of thousands of tons. It is so well sheltered from the sun that it never completely melts.

Instead of trying to clear out the ice, the engineers made new cuts at a lower level. Now the cold from the ice chills the air sufficiently to force it down through the passage ways of the workings and drive smoke and gases before it, pushing them out through openings cut to the surface at the new workings. Post-war planners, please copy!

Steel Scrap Need Is Intensified

Our national inventory of iron and steel scrap declined over 11% from June, 1943 to Dec. 31, 1943, or to 3,775,000 tons. Yet with the shooting becoming more intense we are using up steel faster all the time. We expended 34,000 tons of steel in Italy in February. At Kwajalein Atoll alone we dropped 15,000 tons in bombs and shells. In 1943 we delivered to our fleets and those of our allies 24,000 vessels of all types and this year we are scheduled to top that by 100%, a conspicuous part of which will be landing craft.

These facts were recently announced by the American Industries Salvage Committee on the eve of the release of a new moving picture, "Behind the Winning Punch," which is destined to be shown before thousands of key industrialists within the next few months. There are several scenes of battle action where bombs and shells are being expended.

The most urgent demand is for heavy melting carbon steel scrap.

Alloy Steels—War and Post-War

It will probably be many years—unless the war continues longer than is now expected—before the record total of alloy steel produced in 1943 will again be equalled or surpassed. Last year's output of 13,116,000 net tons of ingots and steel for castings was nearly 14 per cent in excess of the previous record of 11,526,000 tons made in 1942. It is also four times the 1939 production. There was a continual decline in production each month since the peak of 1,284,000 tons in March due to a progressive decline in demand. These statistics come from the American Iron and Steel Institute.

These data do not fully comprise the total alloy steel production of the country. The alloy steel castings, made by the steel foundry industry—a substantial tonnage—are not included in the Institute's totals. Another consideration is the fact that, according to the Institute's classification or definition of alloy steels, some steels generally recognized as alloy steels are not included. It is evident that the country's total would be appreciably higher, if all factors were included.

Of interest also is the Institute's statement that last year about 70 percent of the total alloy steel output was made in open-hearth furnaces and about 30 percent in electric and crucible furnaces—practically the same ratio that prevailed in 1942. Before the war, however, the open-hearth was credited with 75 percent of the total. These ratios—such a large proportion of alloy steel made in open-hearth furnaces—are contrary to the general impression. The record for 1943 shows a gain in the electric furnace output over pre-war years.

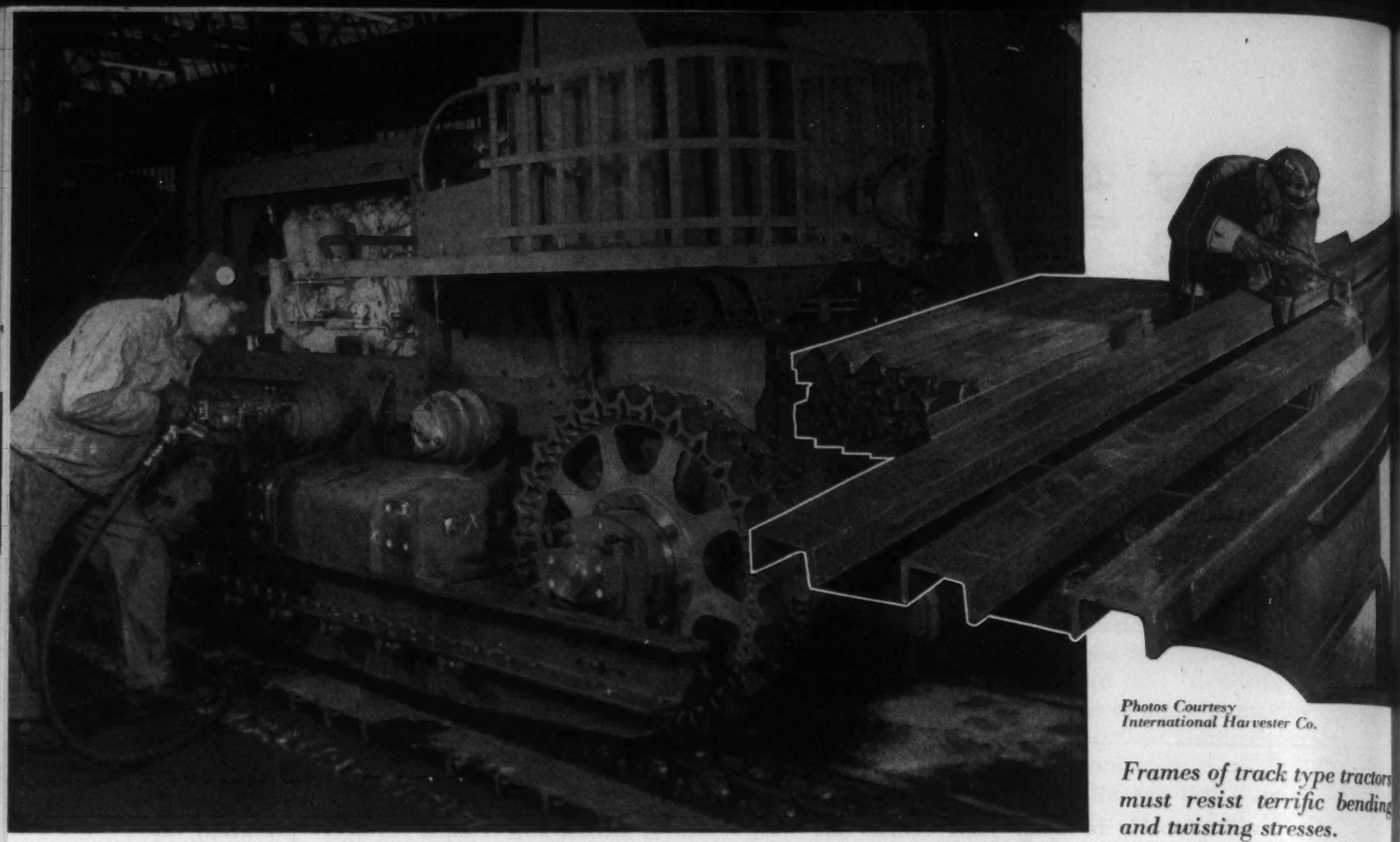
Just what the ratio will be in the post-war era, it is unwise to predict. It is evident, however, that with the very large war expansion in electric furnace capacity, electric furnace steel will be an intensive competitor with the open-hearth. Much will depend on economic and financial conditions, but these being reasonably equal, electric steel should have a fairly clear track. Its superior quality, especially for high-grade steels, and its relatively greater consumption of scrap, both plain and alloy, are in its favor. Also most of the NE steels are an open-hearth product accounting in part for the large open-hearth alloy production. If there is a recession in demand for these steels—and some think this will be substantial in the post-war period—the relative net result will be an increase in electric alloy steel.

—E. F. C.

Foundry Engineering Progress

On the occasion of the annual meeting of the American Foundrymen's Association and the publication of this, our "Foundry Show" issue, we are impelled to say a word or two in recognition of the considerable technical progress that the foundry industry has made in recent years — progress both in improving the efficiency of manufacturing operations and in enhancing the properties of castings of all types.

According to *Penton's Foundry List* there are some 4800 foundries in operation in this country, of which 2890 make gray iron, 600 steel or alloy castings, 126 malleable cast iron, 2620 brass and bronze castings and 2040 aluminum or magnesium castings. In actual weight of delivered castings the gray iron branch of the industry is the colossus, its tonnage production being in the neighborhood of 14 million tons annually (actually more than the com-



Photos Courtesy International Harvester Co.

Frames of track type tractors must resist terrific bending and twisting stresses.

Stronger Backbones for Tractors Using Inland Hi-Steel

Tractor frames must be strong—particularly those for track type tractors, which are turned by stopping one track, throwing terrific bending and twisting stresses onto the frame. That is why a manufacturer of tractors chose Inland Hi-Steel for the frames of their 10-ton track type Diesel tractors; Hi-Steel offers higher strength without added weight or size.

The original tractor design called for steel with 44,000 lb. per sq. in. yield strength. For the grueling service to which these tractors are subjected, especially when a bulldozer is mounted directly on the frame, it was found that greater strength was needed. Increasing the size of the frame section would have entailed complete redesign and sacrificing many desirable tractor features.

Inland Hi-Steel offered the perfect solution to the problem. Replacing the carbon steel channels with Hi-Steel, which has a yield strength of 57,000 lb. per sq. in., made possible retaining the same size and weight of frame, while increasing strength 29.5%. All design features were retained, and adopting Hi-Steel called for no change in fabricating methods. Thousands of these sturdy, powerful tractors in service confirm the dependability of the Hi-Steel frames.

Inland Hi-Steel, the corrosion-resistant and high-strength, low alloy, has established records for service and endurance on many of the toughest peacetime and wartime jobs. Today, most of the Inland Hi-Steel goes into war jobs but when peace comes, it will again be available for the construction of equipment in which higher strength, reduced weight and greater corrosion resistance are factors in product design, sale and service.

INLAND STEEL COMPANY

38 S. Dearborn St., Chicago 3, Ill.

Sales Offices: Cincinnati • Detroit • Kansas City • Milwaukee • New York • St. Louis • St. Paul

bined output of all other engineering materials except steel). Steel castings added up to about 2 million tons in 1943, "malleable" about 1 million and the total of brass, bronze, aluminum and magnesium about 2 million.

These figures are cited to show the importance of the foundry in our economy and to indicate the relative size of the various branches of the foundry industry. If foundries are backward technically (as is widely believed) then such backwardness is almost a fundamental flaw in our industrial structure. If, however, the foundry industry is progressive (as is actually the case), if it utilizes new scientific concepts and modern engineering practice and if it has provided its own solid base of forward-looking research and development, then we may expect its influence in the American industrial scene to grow and the market for castings to expand continuously.

Although the products of the foundry are quite unlike metallurgically and tend to find different types of application, the various branches of the industry are strongly bound to each other in the similarity of methods and techniques they employ and in their common marketing problem of presenting the casting as a competitor with forgings, die castings (not usually considered foundry products) welded structures and other forms. They have a common technical association (The American Foundrymen's Association), which has provided sound, often brilliant leadership in advancing the application of metallurgical and engineering science in all branches of the field.

Because of this, "foundry engineering" today is an actuality and the average foundry is no longer a rule of thumb, by-guess-and-by-God, handcraft shop. A frequently remarkable level of product quality and operating efficiency is fast becoming the rule (although the exceptions are still too numerous, in the minds of industry leaders).

Recent outstanding advances in foundry engineering have been in five general directions: (1) the "metallurgical" improvement of product quality and soundness through the use of modern refining and alloying methods and the application of scientific knowledge of the internal structure of metals, (2) the development and application of specially effective casting processes and molding practices like centrifugal casting, duplexing and triplexing, plaster molding, directional solidification and blind-risering, (3) the use of "sand control" to improve the surface and internal quality of castings through scientific formulation, treatment and testing of mold and core sands, (4) the general mechanization of foundry operations from the conveyorized pouring of molds through the mechanical handling of sand for conditioning treatment and reclamation, and (5) the employment of the latest quality-control tools — X-ray and radium inspection, the metallographic microscope, pyrometric control instruments for melting and pouring temperatures, spectrographic analysis for raw material and finished casting composition control, statistical methods, and so on.

The application of foundry engineering has been well distributed throughout all the branches of the field. It is not slighting the others, however, to say that the steel castings and light metal castings manufacturers have embraced modern methods and metallurgy in the greatest proportions. On the other hand the most notable single trend in the whole foundry field in recent years has been the steady improvement in the engineering quality of gray iron castings made by many well-managed foundries and the extraordinary betterment of properties achieved by a smaller number of plants using special processing techniques.

The foundry industry is basic in our industrial economy. It has successfully met the shock of war, continued to improve its technological level and will enter the post-war period better able to meet the competition from wrought products than ever before in its history. —F. P. P.

Use the Machine to the Limit

At a meeting of the New York section of the American Welding Society, George F. Wolfe, chief engineer of the Dravo Corp., sounded a warning to industry to use to the limit all mechanical methods available in the post-war era. "We face bitter and perhaps ruinous competition from at least four other countries, and we can meet this competition only if our production facilities are utilized to the maximum," he said.

Mr. Wolfe was speaking specifically of restraints upon the use of automatic welding devices, but his warning is equally valid in every branch of industry. However, American industrialists need not be unduly alarmed. We have met the competition of countries with lower wage scales and subsidized industries before. True, it will be much more severe in the future, because we have taught our prospective competitors many of our methods of mass production, the secret of our high productivity. But American engineers are still the most ingenious in the world, and can be expected to bring us through, but only if they can make full use of every cost-cutting trick in the bag.

The combination of low wages and government subsidizing in the foreign countries can make a difficult nut to crack. It was difficult in the pre-war period when, in certain lines requiring individual skill by the workman rather than mass production techniques, we were sometimes outclassed. As an example in point, a speaker at the American Meteorological Society's annual meeting in January told of his experience in attempting to purchase an optical instrument a few years before the war. A famous German firm offered the item for $6000. Adding on 100% duty brought the price to $12,000. Yet the best a leading American firm could do for a comparable instrument was $15,000 to $18,000.

(Continued on page 880)

Charging machine operator about to empty a charging box of limestone into an open-hearth furnace. (Courtesy: United States Steel Corp.)

Increased Open-Hearth Productivity

by C. D. KING *Chairman Operating Committees, U. S. Steel Corp. of Delaware, Pittsburgh*

The Open Hearth Committee of A.I.M.E., which meets this month in Pittsburgh, represents perfectly the 3-way cooperation among engineers, operating men and metallurgists that is essential to better open hearth practice. Mr. King in this article underlines the importance of that cooperation by showing how increased production from given furnace equipment may be achieved by increasing the time available for melting as well as by the usual approach of shortening the charge-to-tap time. Reduction of the time required for rebuilding bottoms and banks and consumed by operating delays would thus be a long step toward increased productivity and Mr. King offers several engineering suggestions in this direction.
—The Editors

THE PERFORMANCE of American open-hearth plants in successfully meeting the demands for the war effort has been one of the most brilliant episodes in the history of the steel industry. In spite of increasingly difficult problems of man-power, quality and adequacy of raw materials, and severe melting conditions due to the rapid increase in open-hearth alloy ingot production, every demand made on the open-hearths has been successfully met. The accomplishments are an eloquent tribute to the men who manage the plants and make the steel. Their achievement is recorded as follows:

Year	Total Open-Hearth Production, Net Tons	Alloy Open-Hearth Production, Net Tons
1940	61,573,000	3,675,000
1941	74,400,000	5,740,000
1942	76,502,000	8,133,000
1943	78,600,000	9,220,000

Behind these production figures lie the efforts and studies of countless men who have contributed to this development. For many years operators have given consideration to improved furnace design, equipment, and steelmaking practices which would yield faster melting, more heats per furnace and greater output. To a large degree these efforts have been devoted to a reduction in the "charge-to-tap" time. Without exception, all open-hearth plants can today boast of more tons per melting hour per furnace than was possible a decade or more ago.

The great wealth of effort which has been concentrated on this phase of open-hearth productivity is clearly evidenced in published literature and other avenues of expression. Much information has been published on methods of improving furnace design, burners, instrumental control, sealing and insulation of furnaces, and other operating techniques contributing to improved furnace output. Similarly, a great deal of data is available on the advantages of varying percentages of hot metal, controlled limestone charges and slag manipulation, minimum slag volumes, rapid analytical methods, and other metallurgical practices resulting in faster melting.

More recently, considerable discussion has arisen in connection with the use of improved charge ores, the value of blown metal in stationary furnaces, the use of "synthetic" scrap, and other similar factors, all of them aiming toward a reduction in the charge-to-tap time. Without these progressive developments and many more well known to present day steelmakers, present production levels could not have been attained.

Melting Time vs. Outages

However gratifying such improvements may be, and there is every reason to believe that continued effort will be made in this direction, one cannot assume that a reduction in charge-to-tap time alone exhausts the potential productivity efforts of open-hearth plants. Equal efforts are required to increase the available time for steel melting since maximum production can be obtained only by minimum charge-to-tap time combined with maximum availability for steelmaking. It is not always realized that the actual time a plant is engaged exclusively in "steel melting" constitutes in some cases less than 75% and rarely more than 85% of the total available time. It is, therefore, apparent that an increase in the available steel melting time is equally effective in achieving maximum productivity of an open-hearth shop as is the more spectacular and, perhaps, more popular approach of reducing the time of heats from charge to tap.

If maximum production of open-hearth furnaces is required, as it is at present, the annual total time can be accounted for in three main divisions: (1) Rebuilding; (2) operating delays; (3) melting. While the influence of excessive rebuilding time and operating delays on open-hearth productivity is appreciated by all open-hearth operators, its magnitude is not always clearly understood. A hypothetical example (Table I) may be helpful in illustrating the effect of various outages on the productivity of a furnace tapping 150 net ton heats, whose charge-to-tap time for the conditions outlined is considered constant at 9 hr. and 30 min.

Table I.—Time Lost Through Various Outages

Condition*	Total Available Furnace Time (1)	Outages for Rebuilding		Operating Delays: Fettling, Bottom, Stock, Hot Work, Mechanical and Miscellaneous		Total Outages		Available Steelmaking Time	
		Hours	% of (1)	Hours	% of (1)	Hours	% of 1	Hours	% of 1
A	8760	876	10.0	1177	13.4	2053	23.4	6707	76.6
B	8760	526	6.0	957	10.9	1483	16.9	7277	83.1
C	8760	350	4.0	678	7.7	1028	11.7	7732	88.3

*Condition "A" represents excessive rebuilding time and operating delays.
*Condition "B" represents fair rebuilding time and operating delays.
*Condition "C" represents good rebuilding time and operating delays.

Table II.—Effect of Outages in Table I on Production Tonnage

Condition	Charge To Tap	Tons per Hr. Melting Time	Delays — Min. per Heat	Tap to Tap Time	Tons per Operating Hr.*	No. Heats per Yr.	Total Production (Net Tons)	Relative Performance with "C" at 100%
A	9′ 30″	15.8	100	11′ 10″	13.4	706	105,900	86.7
B	9′ 30″	15.8	75	10′ 45″	14.0	766	114,900	94.1
C	9′ 30″	15.8	50	10′ 20″	14.5	814	122,100	100.0

*Total available furnace time less rebuilds.

Resolving the above data (Table II), it will be observed that the difference in annual production between the extreme cases selected amounts to approximately 16,000 tons per furnace per year, equal to a 15% increase in productivity. To obtain this increase in production merely through faster melting would require a reduction in time of heat from 9 hr. and 30 min. to 8 hr. and 15 min.

Year	Plant "A"		Plant "B"	
	Total Hr. Lost Per Yr. Due to Rebuilding	% of Total Lost Time	Total Hr. Lost Per Yr. Due to Rebuilding	% of Total Lost Time
1940	9,876	8.07	8,575	7.01
1941	9,132	7.46	6,317	5.16
1942	4,774	3.90	6,000	4.90
1943	4,948	4.04	5,585	4.56

The latter procedure has occupied the interest of all open-hearth operators for many years, and not infrequently to the exclusion of equal consideration of other methods which contribute to increased production. Due to the urgent need for additional steel from presently available facilities, this question is now beginning to assume its rightful importance.

Molten pig iron from a blast furnace being charged into an open-hearth furnace (Courtesy: United States Steel Corp.)

Before any intelligent effort can be made in the direction of reducing the outages occasioned by operating delays and rebuilding, it is necessary to know exactly the character, magnitude, and frequency of these delays. Every open-hearth plant records these occurrences in some manner or other. Since the total lost time is made up of a great variety of minor delays, it is necessary to record accurately all delays in a reliable, detailed manner. Bottom delays, for example, can be divided into fettling; bottom, bank, and tap hole delays. If required, further refinement of these broad divisions may be made in order that the exact cause of the delays may be ascertained and, where possible, the necessary corrective procedures instituted.

Improper recording is not only ineffective, but can also be misleading. For example, if it is customary to consider the charging time as beginning with the first box of materials charged, even though subsequent charges may be seriously delayed, the records in such an instance would indicate no delays on stock. However, the time of heat from charge to tap might be unduly extended, and efforts concentrated along the lines of improved furnace design and equipment. This, in itself, is a laudable procedure, but in this particular instance the true corrective measure might lie in adequate rolling stock, charging facilities, or other items contributing to a lack of available stock when the furnace is ready. In studying stock delays it, therefore, would be necessary to supplement the item shown as "beginning of charge" with another showing the "time when charge is completed."

Each main group of delays can also be correlated with the tonnage lost per furnace per month or year, as desired, in order to clearly indicate the magnitude of the losses involved.

Furnace Rebuilding

Rebuilding of furnaces may consume as much as 10% of the total available hours in a year, or as little as 4% and, as a rule, may represent as many lost hours as all other operating delays combined. Therefore, it presents one of the most attractive means for increasing the productivity of a plant whose efforts in this direction may not have been as concentrated as in reducing the charge-to-tap time. The application of rebuilding schedules has proved

very useful in reducing the hours lost, since bunching of furnace rebuilds is avoided.

In addition, it assures the rebuilding of furnaces before the time of heat has been unduly extended during the last part of the campaign. Not only is scheduling of rebuilds a desirable procedure from the standpoint of the open-hearth shop, but even more so for the entire plant, for under present day conditions, with limited maintenance, masonry, and other service personnel, a planned program is required to utilize such services to the best advantage.

With scheduled rebuilding, pre-planning of the rebuilding work is desirable. This involves cooperative prior study of the job by the open-hearth maintenance, and masonry departments, and the advance arrangement of personnel, material and services required in the rebuilding. The sequence of repairs as outlined for the job should be adhered to as closely as possible except for changes dictated by special conditions which may arise. Much of the preliminary work around the furnace can also be arranged prior to tapping the last heat.

Many plants have also adopted incentive systems for rebuilding as well as hot work repairs. Many of these are fairly complex in character but the results are uniformly successful.

Modern plants are designed to assure maximum availability of steel melting hours and provide, as a rule, ready accessibility of materials to and from furnaces during rebuilding. Older plants are physically limited in many respects, but even they may benefit by the use of various mechanical aids, where possible, to reduce labor requirements and expedite rebuilding. The following represents a partial list of some of the methods now being employed by various plants, although not all of them are used by one and the same unit:

1. Elevators for raising brick to floor level or above.
2. Power conveyors for handling debris from checker chambers to cars.
3. Gravity conveyors for unloading and distributing brick.
4. Hoists or other methods of expediting removal of dust from flues.
5. Trucks for loading or unloading above floor level.
6. Tractor shovels for general clean-up work including loose slag pocket material.
7. Expediting slag removal from slag pockets by slag breaking beams, use of "Cardox," employment of false walls, auxiliary slag pockets, use of hoes, etc.
8. Containers or boxes to catch debris from main roof.
9. Portable platforms for rebuilds and repairs.
10. Fans for forced cooling.
11. Construction of brick arches at floor level between furnace binders in side, end, and division walls to enable bricklayers to complete work above floor level while remainder of furnace is being torn out.
12. Air sprays for sealing furnace system after rebuilding.

Basic end walls have proved advantageous at many plants even where limited slag pocket volumes have not constituted the limiting factor in the useful life of the furnace. Where physical limitations prevent enlargement of the slag pocket or use of rapid means of cleaning the pockets, the use of basic brick in end walls is axiomatic. Some plants have even carried this development to include basic brick over the port roof. The amount of slag has been materially reduced and the physical character radically changed, making it possible to readily rake the slag out of the pockets.

Another aid to rapid rebuilds has been the use of permanent soot blowers installed in the rider walls of checker chambers. This assures a minimum amount of dust to be handled during rebuilds. Periodic blowing of checkers is also essential for the same reason, apart from its beneficial effect on the operation of the furnace between rebuilds. In addition, there has been a general tendency toward a more rapid increase in the operating temperature of furnaces after rebuilds. This is quite understandable, since a moderate temperature rise is required on a new roof only through the cristobalite reversion range (480 to 600 F.). As a matter of fact, experience at many plants indicates that 35 to 40 hr. from "fuel on" to tap is adequate.

To indicate the substantial reduction in rebuilding outages that has been obtained at several plants employing some of the methods outlined, we cite the following:

Plant "A" taps 117 net ton heats with a production per melting hour of 9.9 net tons, so that the reduction in rebuilding outages of 4,928 hr. in 1943 compared to 1940 represents a gain in annual output of approximately 49,000 tons for the shop, or 4%.

Plant "B" taps 188 net ton heats with a production per melting hour of 15.6 net tons. The reduction of 2,990 hr. in rebuilding time in 1943 compared to 1940 represents a gain of 46,600 tons per yr., or approximately 3%.

Operating Delays: Bank and Bottom Repairs

In the sense used in this discussion, operating delays signify all outages except rebuilding time. Operating delays, therefore, cover bottom repairs, stock and charging delays, hot work, mechanical repairs, and miscellaneous delays. The difference between charge-to-tap time and tap-to-tap time is normally represented by operating delays. In general, operating delays may be as little as 6 or as much as 15%, or more, of the total possible operating time and, therefore, represents a profitable avenue for increasing the productivity of open-hearth plants.

Over a year's period, fettling and bottom repairs constitute from 30 to as much as 100 min. per heat, and generally make up from 50 to 80% of all the operating delays. Fettling, or the redressing of normal erosion of banks and bottoms, is as much a part of the steelmaking process as is the charging of the heat. Therefore, it cannot be strictly considered a delay even though it does reduce the actual time available for steel melting. For a given sized furnace, fettling time is fairly constant, but from shop to shop it may vary from as little as 20 min. per heat to as much as 40. This item, in some cases, is amenable to improvement by the use of mechanical bottom-making machines which, to this extent at least, ameliorates working conditions as well as reduces the man-power required. Some plants re-

Taking a sample of steel for analysis from the bath of an open-hearth furnace. (Courtesy: United States Steel Corp.)

port from 10 to 20 min. saved by the use of such equipment. A further minor reduction in fettling time has been accomplished at some plants by making up the slag line while the heat is being tapped.

In addition to normal dressing or fettling of the furnace bottom, there are innumerable bank, bottom, and tap hole repairs resulting from serious erosion. These bottom repairs constitute a true delay, and all open-hearth plants are subject to them to some degree. Over the period of a year, these repairs may average from as little as 10 min. per heat to as much as 90, and depend on many factors such as the age and condition of the bottom, the type and amount of pig iron, the type of scrap, the refining time involved, and a large number of other factors. They constitute a serious steel quality problem as well as a potential source of major delays. Plants, at which average time for such repairs appears to be modest, may find on closer analysis of individual furnaces that some of these furnaces show exorbitant delays of this character. In such cases, the present availability of quicksetting refractories makes it possible to take such furnaces off for major bottom repairs such as resurfacing, or even a complete new bottom, sacrificing for that particular period the utility of the furnace in order that its productivity over the year's period may be increased.

In the past, this procedure was avoided as far as possible by most plants since it involved an extended outage due to the need of sintering in the magnesites used. At the present time, because of the availability of fast-setting materials, the time for similar or equivalent operations is now less than half that formerly required. For this reason, each plant must determine, under its own conditions, the point at which the profitable life of the bottom has been exhausted, and the advisability of resurfacing or even installing a complete new bottom.

The use of oxygen lances for burning steel out of tap holes is a common but indispensable adjunct to modern operation. Furthermore, many plants have reduced the time required for bottom repairs by the use of compressed air for cleaning out steel and slag in holes. One plant has expedited the draining of deep holes near the center of the bottom by providing auxiliary tap or drain holes built into the bottom of the hearth on each side and about 18 in. below the level of the tap hole. The brick in the auxiliary holes is removed and an oxygen lance used to burn through the bottom material and to the hole in the bottom to be drained.

The use of sloping backwalls is a prerequisite in modern open-hearth practice and eliminates virtually all troubles previously experienced with vertical silica walls. Basic front walls have contributed to a modest reduction in bank delays occasioned by the

erosion of silica front walls, in addition to a reduction in the time of hot work repairs.

To illustrate the reduction that has been accomplished in bottom delays, we cite the experience of one plant employing the several suggestions indicated:

Year	Delays—Min. Per Heat	
	Fettling	Bottom, Bank and Tap Hole Repairs
1940	30	33
1941	30	29
1942	31	20
1943	31	14

It will be noted that the fettling time is constant but that the bottom repair time has been reduced from 33 to 14 min., or approximately 19 min. saved per heat. This is equivalent to 1348 hr. more time available for steel melting which, at the plant in question, amounts to 14,500 tons, or a 1.5% increase in production.

Charging Delays

Charging delays also result in serious production losses. At the more fortunate plants, these delays, for a year's period, may be nil, but at others may average as much as 30 min. per heat, a situation aggravated both by a great number of furnaces in a row as well as the use of bulky scrap in large quantities. Here again, an accurate and detailed record must be maintained in order to indicate the cause of delays. To illustrate, stock delays can be arranged in the following manner:

1. Waiting for other furnaces to charge.
2. Waiting for ore and limestone.
3. Waiting for scrap.
4. Waiting for cold iron.
5. Waiting for hot metal.
6. Miscellaneous.

Some of these delays may be due to lack of raw materials. In other cases, inadequate stockyards, assembly tracks, cross-overs, insufficient charging machines, inadequate size or number of charging boxes and buggies, or other reasons, may exist for lost production. Such delays result not only in the loss of steel productivity due to recorded time lost, but frequently in extending the time of heat due to improper charging conditions. If changes or additions in facilities are required to eliminate such delays, an accurate record is helpful in demonstrating the need for such facilities.

Hot Work Repairs

Hot work repairs cover normal brick repairs required during the campaign of the furnace, such as roof patches, front and end wall repairs, port and port roof repairs, and include changing charging doors and frames, and similar stoppages. They normally represent a potential loss over a year's period averaging from 5 to more than 20 min. per heat, and constitute an important source of delays not only due to the time actually incurred in furnace outage, but because of the adverse effect of cooling the furnace and extending the time of the initial heat after repairs are completed.

The same pre-planning principles mentioned with respect to rebuilding apply with equal force to major hot work repairs. Proper incentive systems are also valuable in expediting such repairs. The use of basic brick in front walls and end walls has materially reduced such repairs at many plants. Some units have found archless door frames to be advantageous in minimizing the damage frequently resulting from charging bulky scrap. Other plants have resorted to the use of improved water-cooled skewback channels, front wall coolers for the support of door arches, bulkhead coolers, water-cooled burner blocks, etc., with satisfactory results. Not infrequently, plants are prone to accept a considerable loss of time incurred by repeated hot repairs, when the true solution lies in the reconstruction and redesign of the furnace proper.

Mechanical repairs and other miscellaneous delays normally constitute a relatively small loss in productivity. Occasionally some plants may find that these delays have an important effect on the output of the shop due to too few or overloaded charging machines, cranes, and transportation facilities. An exact record of such delays will be found helpful in providing a basis for the consideration of adequate equipment.

Teamwork Boosts Productivity

Open-hearth productivity is affected both by the speed with which heats are produced as well as the time available for such steel melting. Maximum output can be obtained only from the combination of the shortest time from charge to tap and a minimum lost time for rebuilding and operating delays. Far-sighted open-hearth operators have for many years supplemented their own experience with that of metallurgists in improving steel quality. They have similarly taken advantage of the assistance of fuel engineers and other technologists in redesigning furnaces, improving fuel consumption, installing control equipment, and similar procedures.

Since maximum availability of the open-hearth shop for steel melting is, to a large degree, a function of materials handling, open-hearth operators can, no doubt, benefit by calling on the assistance of trained engineers in this particular field. A reduction in rebuilding outages and operating delays is not a simple problem, because such delays are to a large degree the result of numerous and seemingly minor losses. Improvement in this field can be accomplished only by the most persevering efforts.

Productivity of an open-hearth shop is truly a matter of teamwork. The skill of the first helper, operating the furnace to produce heats in a minimum time, is utilized fully only if the maximum time is available to him in which to exercise it. The stocker, the charging machine operator, the locomotive engineer, the masons, the maintenance crew, and all other members of the plant organization are equal members in this team effort. Without the wholehearted cooperation of every individual in the shop, full productivity cannot be obtained. Management and labor, working together, supply the answer.

Radius tools are tipped in the same manner as other types. The center tool is 5 in. across and weighs 40 lbs. The entire tool was previously made of high speed steel. The present arc welded design uses a tip of high speed steel weighing 1¼ lbs. — a saving of 38½ lbs.

Tool Tipping by Arc Welding

By **GEORGE W. GIVEN** *Foreman, Heat-Treating Dept., Falk Corp., Milwaukee, Wis.*

The conservation benefits and operating economies derived from the use of tipped tools, in which hardened high speed steel tips are affixed to ordinary steel shanks, are being increasingly enjoyed. Arc welding for this purpose has generally been avoided, but Mr. Given shows in this article that arc welding with a suitable electrode *can be both simple and satisfactory.*
—The Editors

The tipping of low carbon shanks with high speed bits or inserts has been widely practiced, particularly in the case of tools for heavy planers and lathes. The two most common methods of tipping have been brazing and cementing, the latter carried out with a proprietary cement. Both methods are well known and have given good results when properly handled. However, both brazing and cementing require considerable skill and practice, and this fact led to the development of the arc welding technique for tipping described here.

Tipping by means of the electric arc consists of welding a *hardened* high speed bit or tip to a carbon steel shank. The tips are completely prepared before welding. No special treatment is used in hardening the tips other than careful heat treatment in controlled atmosphere furnaces and drawing in accurate forced

convection tempering equipment. The shanks are not heat treated, other than for normalizing in cases where excessive forging temperatures are suspected. When the weld has been completed and the tip ground the tool is ready for service without further treatment.

The welding method offers several advantages over conventional tipping procedures. It is quick, simple to perform and gives service equal to solid tools. It is obviously not suited to cut-off tools and other small tools which require little high speed steel. Metallurgically, perhaps, there may be some objections to welding a hardened section of high speed steel; however, practical experience over a reasonable period of time indicates that the method is entirely feasible, and that the affected or softened zone in a properly welded tool is small enough to be negligible. This is indicated in several of the illustrations in this article. It has been found that the tool can be ground down to within 1/4 in. of the weld before replacement of the tip is necessary.

Welding Technique

The problem of arc welding involves the following three factors:

(1) To weld without drawing hardness of the tip.
(2) Prevention of cracks in the tip or at the weld.
(3) Shank design.

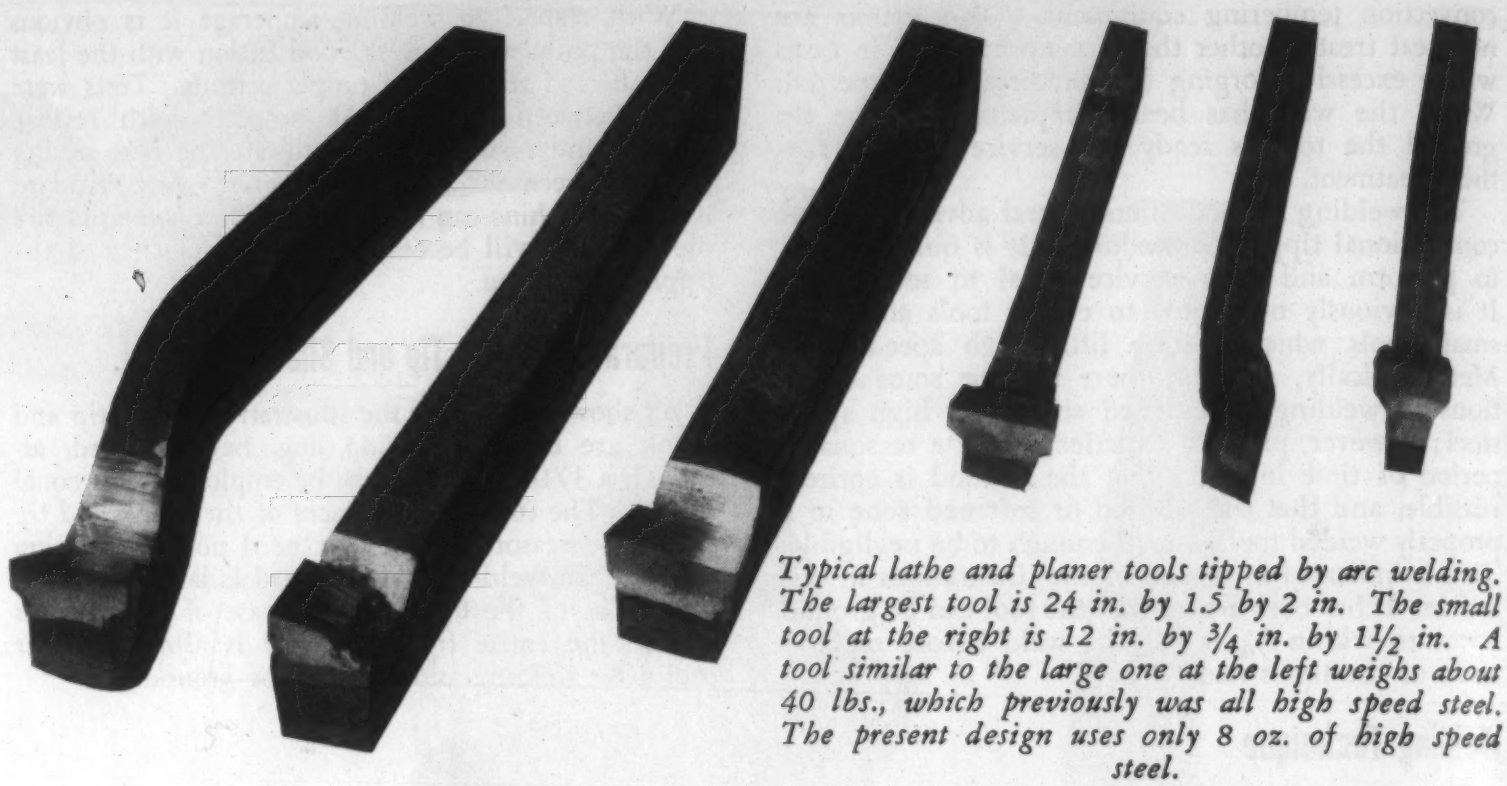
Various types of welding rod were used experimentally to determine which produced the best results. These included 18-4-1, high carbon, 18-8 stainless, 25-12 stainless, and mild steel. As was to be expected the high carbon rod was least successful. The tests with 18-4-1 rod were limited in scope so we can draw no fair conclusion. Mild steel rod was fair; 18-8, and 25-12 worked out best. A 1/8-in. dia. rod was used in all tests.

With respect to welding amperage it is obvious that the point which gives good fusion with the least heat affected zone is the proper setting. Tests were made between 90 and 130 amperes with reverse polarity and results to date indicate the best setting to be between 90 and 100 amperes. Any standard welding machine can be used, and after some practice the operator will become speedy and efficient at the tipping operation.

Preparation of the Tip and Shank

As shown in one of the illustrations, both tip and shank are beveled. A 45 deg. bevel is used, although a 3/16-in. radius can be employed with equal results. The contacting surfaces of the shank and tip should be reasonably flat, but need not be precision ground. In welding a single bead is laid around all four sides of the tip, or in the case of radius tools around the entire tip. The tool is allowed to air cool after welding and can then be ground.

A left-hand planer tool with a hardened high speed tip clamped in position ready for the welding operation. A single bead of 18 and 8 steel is laid into the 45-deg. bevel. After welding, the tool is ground and put into service without further treatment.



Typical lathe and planer tools tipped by arc welding. The largest tool is 24 in. by 1.5 by 2 in. The small tool at the right is 12 in. by 3/4 in. by 1 1/2 in. A tool similar to the large one at the left weighs about 40 lbs., which previously was all high speed steel. The present design uses only 8 oz. of high speed steel.

Originally many precautions were taken in the form of preheating and slow cooling. Likewise much work was done on the basis of running two beads instead of a single bead. Cracking of the tip was discouragingly common during, or immediately after running the second bead, and no amount of preheating or slow cooling seemed to help. Trouble was rarely experienced after running the first bead. We held the opinion, however, that a single bead would not suffice. That we were wrong on this point was discovered quite by accident. One day a planer tool broke and it was necessary to rush a replacement to get the machine back into service. No preheat or slow cooling was used, and only a single bead was run as a temporary measure. The tool did its job very well — and quite effectively pointed to the final method, which has become our standard practice.

With respect to shank design some modifications from conventional practice are made necessary when using the welding method. However, generally speaking this is no great problem to anyone familiar with heavy tool design. The shanks are made of 1045, 1050 or any of the similar low alloys, but are not heat treated, as mentioned previously.

A Summary

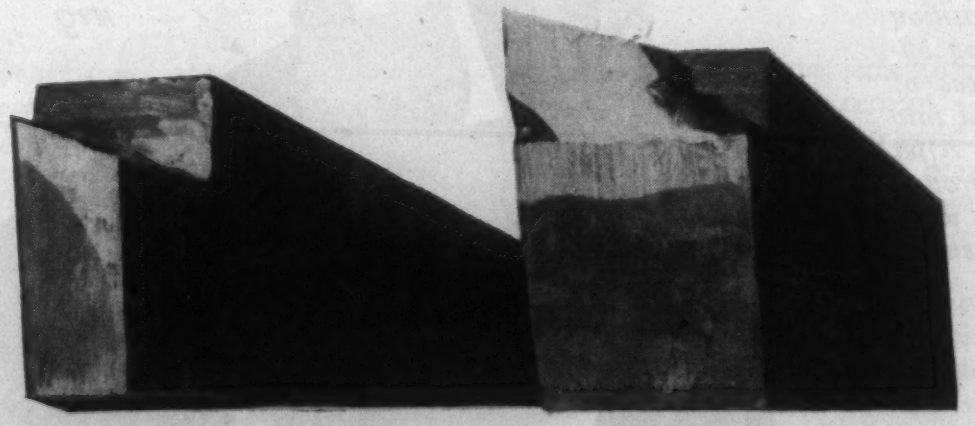
In summarizing our experience with this method of tipping we have found the following advantages:

(1) Conservation of high speed steel. The material being used for tips is the same stock as was previously used for solid tools and has been re-forged.

(2) Shanks can be salvaged and re-used by grinding off the remainder of the tip, and re-tipping. This eliminates a forging operation in replacing a tool.

(3) Tool replacement is greatly simplified. When necessary a tool can be re-tipped in 15-min. A supply of hardened tips is kept in stock at all times.

(4) Less heat treating is required. The poundage of high speed steel treated is very low by comparison with previous practice. Likewise the small sections being handled can be heat treated under far better control than when handling heavy sections.



Planer tools with welded tips (right). The tool on the left has seen plenty of service and has been ground to within 1/4 or 3/8 in. of the weld without loss of hardness of the cutting edge. The tool on the right shows how it originally appeared when ready for service.

Nitriding Ferroalloys

By RALPH H. and DAVE STEINBERG

The advantages of nitrogen-bearing ferrochromium for the production of high-nitrogen alloy or stainless steels have been demonstrated in recent years. The authors of this brief article, seeking a possible extension of this idea to alloying agents other than chromium, have experimentally nitrided other ferroalloys and report herein the best temperatures and other conditions to use. —*The Editors*

NITROGEN, ONCE THOUGHT to be an undesirable element in steel, is now being used as an alloy addition. High nitrogen ferrochromium, added in the furnace to produce high chromium steels, refines the grain size. It also helps to develop the strength and toughness of the metal without sacrificing machinability.

It is possible that the introduction of nitrogen into other types of steels might enhance some desirable characteristics or help minimize some faulty ones. The only commercially available nitrided ferroalloy is high nitrogen ferrochromium which contains approximately 0.7% N. The objects of the work reported in this brief paper were to investigate the possibilities of nitriding various alloys, commonly used in steel making, with a view of determining their economic usefulness.

Iron, electrolytic manganese, low carbon and high carbon ferrochromium, low carbon and medium carbon ferromanganese, low silicon (16%) and high silicon (78%) ferrosilicon were nitrided with ammonia gas at temperatures up to 875 C. (1610 F.). All of the materials were ground to pass an 80-mesh sieve. Two-gram samples were nitrided for 1 hr. and the difference in weight was calculated to percentage of nitrogen. The flow of ammonia was regulated to 100-125 ml. per min.

From the Table, it will be noted that the optimum temperatures for nitriding iron is 400 to 600 C. (750 to 1110 F.), pure manganese is 600 to 800 C. (1110 to 1470 F.), ferromanganese is 600 to 700 C. (1110 to 1290 F.), and ferrosilicon (16% Si) is about 600 C. (1110 F.). In nitriding ferrochromium, much difficulty was experienced in duplication of results. This is attributed to some catalytic effect brought about by the clay boats, and is a matter deferred for future investigation.

In the nitriding of ferrosilicon, the 16% Si type nitrided easily, whereas the 78% did not nitride at all. This fact and the fact that the optimum temperature for nitriding the 16% type agrees closely with the optimum temperature for nitriding iron leads one to believe that the nitrogen is combining with the iron and not the silicon.

In all cases it is to be expected that a longer period of nitriding would increase all nitrogen percentages somewhat. Our results merely point out the temperature that is most efficient and the materials (ordinarily used in steel making) to nitride.

Fortunately, ferrosilicon (16%) and ferromanganese are more or less easily crushed for a nitriding process, whereas steel or low carbon iron is very difficult to crush. However, powdered iron is being sold, although the price is a little high. Ferromanganese and ferrosilicon are essentials in steel making and hence do not add to the cost over and above the cost of crushing and nitriding. Electrolytic manganese, although easily crushed, is expensive.

Table of Percentages of Nitrogen Absorbed in One Hour by Various Materials

Material	660 F.	890 F.	1110 F.	1290 F.	1430 F.	1610 F.
A. Iron	0.7	7.4	6.2	2.0	1.1	1.1
B. Manganese	0.5	4.4	9.4	10.4	10.3	8.3
C. L.C. Ferromanganese	0	1.5	8.1	10.0	6.0	5.5
D. M.C. Ferromanganese	0	6.8	10.4	11.4	7.7	3.4
E. L.C. Ferrochromium	0	0	0.1-0.4	1.6	1.0-1.8	4.7
F. H.C. Ferrochromium	0	0.1	2.3	4.7	1.0-4.4	5.2
G. Ferrosilicon (16% Si)	0	1.6	9.3	—	4.3	3.0
H. Ferrosilicon (78% Si)	0	0	0	0	0	0

A. Analysis—0.20% C, 0.32% Mn, 0.42% Si
B. Analysis—99.9% Mn, electrolytic.
C. Analysis—80.0% Mn, 0.10% C
D. Analysis—80% Mn, 1.36% C
E. Analysis—70.0% Cr, 0.05% C
F. Analysis—68.0% Cr, 4.67% C

One of the first steps is ramming of the molds, shown here. Small molds are made on squeezers, and the sand is shoveled into the flasks. For larger pieces jolt rollover machines, with overhead sand chutes, make for high production. The sand is carefully controlled as to moisture and other properties, and is reconditioned after each use. The foundry, a Dow Chemical Co. licensee, uses sulphur, boric acid, and ammonium silicofluoride as inhibitors in its molding sand.

Modern Magnesium Foundry Methods

WHILE THE VARIOUS PLANTS set up to produce magnesium metal and its alloys are steadily increasing their production, a shortage still exists in capacity for fabricating and casting these lightest of all industrial alloys. One of the foundries which has now devoted its entire capacity to the production of high-grade magnesium alloy sand castings for aircraft use is Hills-McCanna Co. in Chicago. Prior to the war, its operations included other sand cast nonferrous alloys as well as magnesium castings.

Among the parts made are carburetor throttle bodies, landing wheels, brake assemblies, camera parts, gun control and gun turret parts, and parts for air frames. The castings go into nearly every make of American fighting plane. Many of these parts are required to pass a pressure test before acceptance.

We recently visited this foundry and were so impressed with the efficiency of its methods as typical of what advanced magnesium foundries are doing, that we now wish to conduct our readers on a tour of this plant through the medium of the following pictures. —K. R.

The making of cores is an important part of foundry work. A modern coreblowing machine is in operation in this picture. Because of the necessity for close control of properties, core sands are not reworked here, but are sent to an outside concern for complete reprocessing after a single use. Use of different colored core sands for each shift makes it possible to track down bad cores.

The melting and pouring technique is closely controlled. The metal is melted in large oil-fired furnaces, then transferred to crucibles of from 125 to 300 lb. capacity.

These crucibles are placed in small furnaces and the metal heated to 1550 F., then cooled quickly to a predetermined pouring temperature. Pouring is done as quickly and with as little turbulence as possible. The molten metal must be handled with extreme care. Too long soaking at the high temperature will cause a change in the physical properties of the resulting casting.

As with all light-metal foundries, the weight ratio of casting to poured metal is low — from about one-half to one-eighth. The excess metal goes into gates and risers. A cleansing of the metal during pouring is necessary to assure sound castings. This cleansing is termed fluxing. Pouring is shown in these views.

After the cast metal has cooled sufficiently, the molds are taken to the knockout stations. Knockout machines are not much used, due to the danger of damaging some types of castings. Gates and risers are removed by sawing, and the castings are cleaned by flat and rotary files. A chromatizing treatment follows.

Magnesium, the lightest of all structural metals, is one-third lighter than aluminum, and only about one-fifth the weight of bronze. Alloying and heat treating provide good strength properties, A batch of castings is shown as they are being loaded into a heat treating furnace.

Cast Iron for Pressure Equipment

by E. S. CLARK, *Meehanite Metal Corp.*

Because of its economy, machinability and design flexibility, design engineers in the past have frequently specified cast iron for cylinders, valves, fittings, etc., required to hold liquids or gas under pressure, but have traditionally limited such applications to low-pressure equipment not involving close fits. In recent years the applicability of gray iron pressure castings has been considerably extended by the development of high-duty irons (of which Meehanite, discussed here, is a leading example), whose structures make them more leak-resistant and warp-resistant than old-time cast iron. The general requirements that iron castings must satisfy for this type of service and some illustrative instances of successful applications of modern cast irons in the high-pressure field are presented in this article. —*The Editors*

MATERIALS AND FORMS frequently employed for pressure equipment include cast iron, steel castings, brass or bronze castings, steel forgings, welded steel sheet structures, etc. All have specific advantages for particular fields of service: Forgings provide the highest strength or toughness, non-ferrous castings the best corrosion resistance for general service, steel castings the greatest strength among cast materials, and cast iron the lowest cost, the best machinability and wearing properties and the widest design flexibility.

In many situations, the service requires design emphasis on highest strength and in others on corrosion resistance; for such cases the extra cost of steel forgings or castings or of brass or bronze castings is usually justifiable, and cast iron is excluded from consideration. For a large number of applications, however, the strength and corrosion-resistance of modern cast iron are more than adequate and it should be considered for its positive virtues of economy, machinability, high damping capacity, surface characteristics, and so on. The purpose of this article is to aid the selection of the right material in such cases by presenting those qualities of cast iron that are of importance in pressure service and describing some typical successful applications in this field.

Fig. 1. Large capacity gas meters made by Pittsburgh Equitable Meter Co. employ modern iron castings for vital parts operating at pressures up to 500 p.s.i.

Improved Irons Now Made

Iron castings have been used over an extended period of time for the purpose of containing materials under pressure. Water mains together with the appurtenant valves have been made of this material for many years and iron cannon were used extensively at one time.

Pressure containing castings of iron have given on the whole excellent service in the past but where pressure was high or shock loads were involved the irons of the past have occasionally failed to fulfil their function, and breaks have resulted with serious consequences. These failures have occurred in some instances where the static test of the piece and the pressures used in operation have been such as to indicate that no failure should have occurred. Such failures have resulted in the classification of cast iron as an unreliable material for pressure containers and have severely limited the pressure range in which it was thought such a material might be considered.

However, recent advances in the metallurgy of cast iron have resulted in vast improvement in the physical characteristics of this material so that the picture as presented by consideration of the older installations has been radically changed during the past 10 to 15 years. Cast irons of definite and reliable characteristics may now be obtained which logically permit the use of this material with confidence of satisfactory resistance to known loadings. This has allowed the use of higher pressures and in general the use of more reasonable factors of safety in design.

Comparative physical characteristics of the older (but still recent) cast irons and those now available are indicated below:

Property	Older cast iron	A modern cast iron (GA Meehanite)
Tensile strength, p.s.i.	30,000 to 33,000	53,000
Yield strength p.s.i.	24,000 to 26,400	42,400
Compressive strength, p.s.i.	120,000	175,000
Fatigue strength, p.s.i.	unreliable	22,000
Impact value, ft.-lbs. (Charpy)	unreliable	7.2
Modulus of Elasticity, p.s.i.	12,000,000 (unreliable)	21,000,000
Design limit—tension, p.s.i.	2,000 to 3,000	8,000 to 10,000

These values are those indicated by the use of standard test pieces but of further importance is the fact that with the older cast irons uniformity of structure and hence physical characteristics varied inordinately as section thicknesses changed. Thus a dependable increase in strength could not be arrived at by increase in section thickness. The newer high test irons may be so controlled that strength for sections of various thickness may be held closely uniform and therefore dependable designs for higher pressures may be made.

General Requirements

Material to be used in vessels or equipment for containing or carrying fluids under pressure must fulfil the following technical requirements:

(1) The material should prevent leakage;
(2) It should permanently maintain its structural entity;
(3) It should not warp or distort in use so that leaks develop at joints.

Sweating or major leakage through the shell of the container is primarily dependent on the density of the material used and its soundness. The presently available high strength irons afford increased density as compared with the older irons since the specific gravity will be close to 7.4 as against 7.0. This results largely from the lower percentage of graphite present and the character of the matrix. Some characteristic structures of older iron, a good valve iron and a modern high-test iron are shown in Fig. 2.

The high-test irons have definitely a smaller, more uniform grain structure. It has been found that sweating may occur where the grain size is definitely enlarged and in combination with large interlocking graphite flakes. Sweating has occurred although fracture may not show to the eye definite openings or shrinks. The finer grain structure has therefore been found advantageous.

The higher strength irons show definitely higher solidity penetration power—that is, heavier sections may be cast with a more reasonable uniformity than is possible with the lower strength irons. This allows of greater variation in section thickness with uniformity. However, that design for a pressure-retaining casting is best which provides uniformity of section thickness.

Maintenance of structural entity depends essentially upon design but the designing engineer is most often confronted in the design of pressure castings with structures impossible of accurate analysis as to stresses. Empirical methods of design and analysis by means of test-to-destruction are common. Such analysis when based on a material for which the fundamental properties are not uniform may well lead to difficulties and in any event does require excessive safety factors.

The normal hydrostatic acceptance tests to twice the working pressure are insufficient to prove the reliability of the structures in all cases. Particularly is this so where fatigue strength values are unreliable and may therefore be exceeded in use.

In the case of "ordinary" gray iron pressure vessels the design engineer is therefore confronted with a most difficult situation—the analysis of stresses is obscure and in addition the physical properties of the material are often uncertain or non-uniform. On the other hand the use of high-duty cast irons of proper constitution and having therefore known and reliable physical properties removes an element of uncertainty in the use of iron castings under pressure which has been present in the past. Thus, for established designs a reliable factor of safety as against failure may be established or the sections modified with safety.

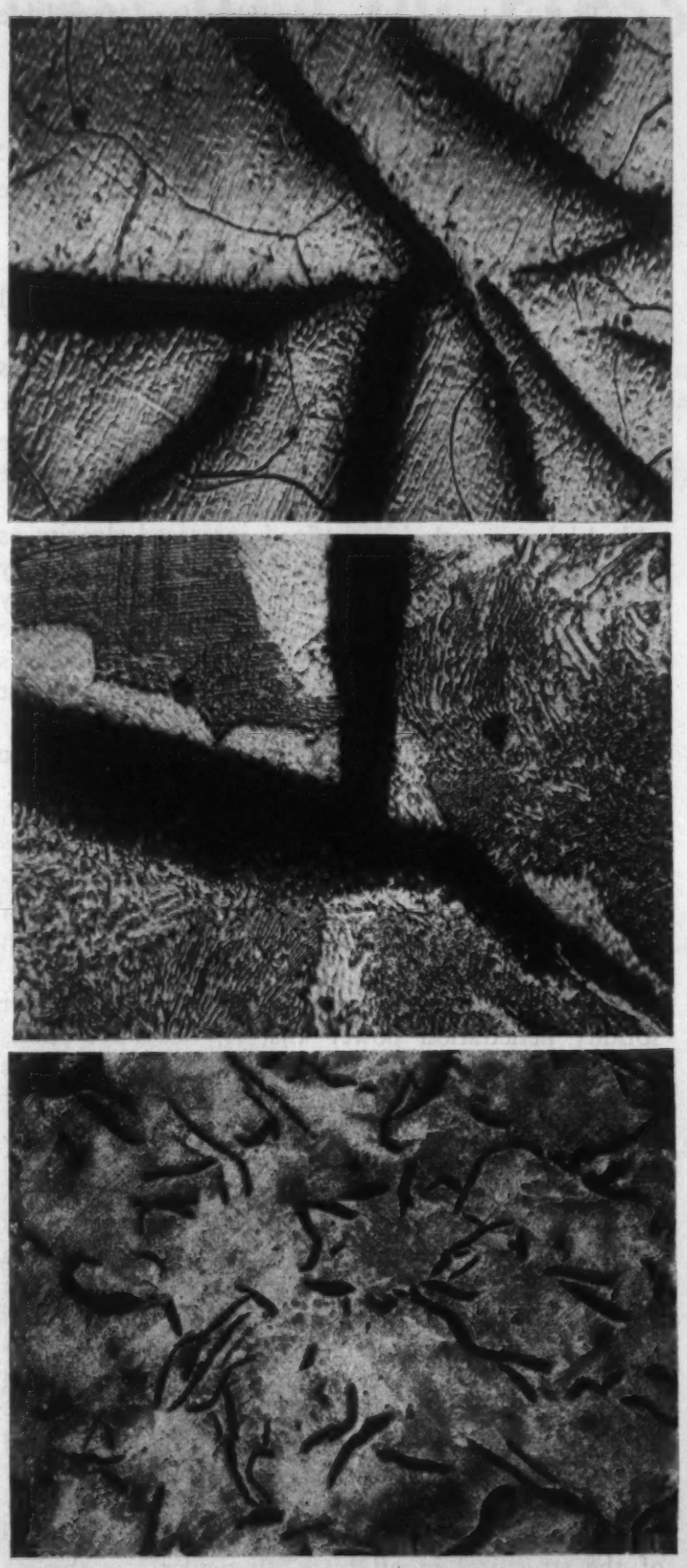


Fig. 2. Microstructures of iron castings directly affect their pressure-tightness. Even at low pressures and temperatures irons with the coarse, interlocking graphite structure shown at the top are subject to seepage; this is an ordinary gray iron with a combined carbon content of 0.04% and a structure mostly ferrite and graphite. A cylinder iron with the structure illustrated in the center (about 0.47% combined C) is better and will withstand pressures up to 250 p.s.i. A modern high-duty iron with finely dispersed, non-interlocking graphite, such as that shown at the bottom (a Meehanite iron with 0.84% combined C and a matrix almost entirely pearlite) will withstand pressures up to 5,000 p.s.i. (All micros 1,000 magnifications originally.)

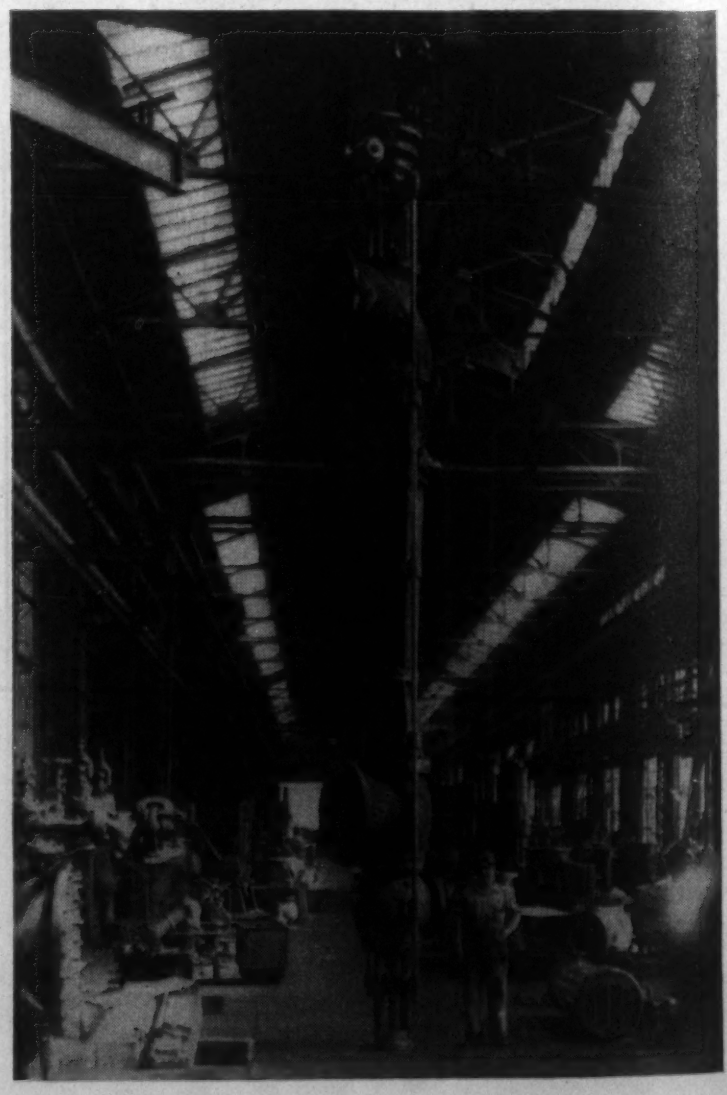
Leakage Through Joints

Where the utility of the pressure-containing casting depends on closeness of fit or accurately maintained clearances of internal parts the rigidity of the presently available improved cast irons is particularly advantageous. In contrast to the older types of irons, the modern controlled-process cast iron has a true modulus of elasticity (21,000,000 and 23,000,000 p.s.i. for the two most common grades of Meehanite, for example).

Designers are thereby assured of true elastic behavior well within the bursting stresses encountered in service, and may plan accordingly. Tensile strength values of the order of 50,000 p.s.i. provide the ultimate protection against failure, of course, but the straight stress-strain curve of a modern high-test cast iron is the guarantee against warping or distortion, with accompanying opening of seals, gaskets, etc. Actual tests on Meehanite valves, for example, have shown that after the application of 40,000 lbs. pressure (twice the maximum working load for the service in question) all parts returned exactly to their original dimensions.

The high-test cast irons also show advantageous stability of structure and physical characteristics at temperatures up to 750 F. Short-time tensile tests on GA

Fig. 3. Pressure casting assembly for use in Boulder Dam. The castings (except for the small manganese bronze casting just above the valve with the large opening) are Meehanite iron—as are all the high-duty iron castings illustrated in this article.



Meehanite, for example, show that its room-temperature tensile strength of 53,000 p.s.i. increases to 56,000 p.s.i. at 500 F., is 50,000 p.s.i. at 750 F. and then drops off rapidly to 25,000 p.s.i. (still a respectable figure, however) at 1,000 F. Young's modulus of elasticity for the same iron is 21,000,000 at room temperature, 20,000,000 p.s.i. at 500 F. and 15,000,000 p.s.i. at 750 F. Grades of ordinary cast iron that were common 15 or 20 years ago possessed tensile strengths of the order of only 20,000 p.s.i. at 750 F. and proportionately low moduli of elasticity.

Applications in Pressure Work

The applications of high-duty cast iron in pressure vessels are growing in number and increasing in the severity of service successfully met, as engineers gradually learn that old-time cast iron and modern engineering-quality cast iron are quite different materials. Valve bodies; valve discs; gas meters; greasing-system fittings; hydraulic cylinders for presses, die casting machines, lifts, dump trucks, compressors and pumps; diesel injection blocks; steam chests, etc., are among the pressure units of various types that have been made out of high-duty irons on a production scale.

Thus for valve bodies the Fulton Foundry & Machine Co., Cleveland recommends GA Meehanite rather than cast steel for large valve bodies for pressures up to 500 p.s.i. They have made them to test 5,000 p.s.i. in small-sized units. The Smolensky Valve Co. uses GA Meehanite for 30 to 50 in. check valves, which had previously been made in cast steel. The steel valves often leaked and had to be welded or plugged; with the cast iron valves not a single casting has yet shown a leak under pressure.

Fulton also reports considerable success in the casting and use by its customer of a vacuum valve disc made of Meehanite iron. The requirements here are the ability to hold an extremely high vacuum and a high hardness to resist abrasion from small particles of broken glass.

As ordinary mild steel would not hold the vacuum an alloy steel forging was used, which was carburized and hardened by a lengthy heat treatment. Great difficulty was found because of distortion after the lapping process and as the depth of hardening was only about $\frac{1}{16}$ in. the discs could only be re-finished and lapped a couple of times. In the process of manufacture, the forgings were ground and lapped after heat treating. They were then checked each month and re-lapped to remove the distortion. This generally took from four to six months.

In the case of the cast iron discs they were simply machined, hardened, ground and lapped and in checking over a four months' period, no distortion was discernible.

Hydraulic Pressure Equipment

Another interesting application is a dump truck hydraulic lifting unit the castings for which are made by the Banner Iron Works of St. Louis. The lifting unit consists of five castings—the main trunnion, a flange cap for the trunnion, two intermediate cylinders, and

THIS ISSUE DEDICATED TO FOUNDRY ENGINEERING AND THE A.F.A.

The editors of METALS AND ALLOYS have given over a large part of this issue to engineering problems involved in the manufacture or application of castings, in tribute to the annual meeting of the American Foundrymen's Association and the accompanying Third War Production Foundry Congress, to be held at Buffalo April 25–28. A summary of the technical program and a tentative list of exhibitors will be found on pages 995 to 1008.

Four full-length feature articles underline the growing importance of sound engineering in foundry practice and of castings in engineering design. The articles include a pictorial visit to a modern magnesium foundry (page 860); a discussion for the designer of the applicability of cast iron in pressure vessels and related equipment (page 864); a practical review for the testing engineer, foundryman and specification-writer of the new technique of fluoroscopic inspection as applied to light metal castings (page 869) and a description of the up-to-date methods and results of blind risering of steel castings (page 874).

Foundry engineers as well as design engineers will be interested in the "File Facts" pages on copper alloy castings on pages 887 and 889.

Fig. 4. This cast iron bottom cylinder for a heavy platen press used in the rubber industry weighs 3140 lbs. and operates at a pressure of 3,000 p.s.i.

Fig. 5. These cast iron cylinders, weighing 1700 lbs. each, are part of a special die casting machine and were tested to withstand a pressure of 6,000 p.s.i.

the piston which is pinned directly to the bottom of the dump truck.

These castings are operated by 600-lb. hydraulic pressure and were formerly made of cast steel which was annealed, machined and then ground. The specifications require that the castings be absolutely sound as the sliding joints are machined to ten thousandths of an inch. Any blow holes or porosity are cause for rejection because of the possibility of the casting's leaking. Slight imperfections also cause excess wear on the leather gaskets used as piston rings.

The manufacturers of this unit state that when these castings were made of steel they had any number of rejections which could not be repaired by welding because any heat applied to the castings warped them to such an extent that they had to be discarded. The Banner foundry has been making these castings of a type GA Meehanite; the castings are quenched at 1,575 F. and then tempered at 900 to 950 F. after which they are machine-finished and ground to size. They have made a great many of these castings with comparatively few rejections and the lifting-unit manufacturer states that he is very well pleased with the material, and that the users of their trucks claim that the cast iron units give better service in the field than did the cast steel because the dust that collects on the cylinders and pistons when they are extended does not score the iron nearly so much as it did the steel.

The trunnion casting is cylindrical, its main body being 12 in. O. D. with one closed end bored and tapped for a standard 5-in. pipe plug. There are two hollow bosses cast on the side of this cylinder which are 3½ in. in diameter. The other end of this cylinder has a 15½ in. x $\frac{11}{16}$ in. flange cast thereon. The inside diameter of the cylinder is ground to 11.0045 in. The flange section is 15½ in. O. D. and made of approximately ¾ in. metal. The total length of the casting is 20½ in.

The larger of the two intermediate cylinders is 20 in. long, and its main body is ground to 10.5015 in. O. D. and 9.3735 in. I. D. It has a flange on one end, which is ground to 11.0015 in. and two chamfers on the inside of one end for leather packing rings. The smaller of the two intermediate cylinders is 20⅞ in. long, the main body being ground to 8.8715 in. O. D. and 7.7437 in. I. D.

The pistons for these jobs are difficult to make because they are closed on both ends and cores must be hung from the cope through an opening approximately 2 in. in diameter. The overall length of this piston is 25⅝ in.; the outside diameter is ground to 5.493 in. and the inside is cored to 4½ in. and is not finished. One end of the casting is flared out to form grooves for leather packing rings and the other end has a large lug which forms the pin connection between the truck body and the piston.

Numerous other applications of iron castings for difficult pressure service could be similarly described and some are illustrated in the accompanying photographs. Enough has been presented to demonstrate that the modern, specially-processed cast irons are not subject to the uncertainties and stigmas of the "cast iron" of years ago and are of as much practical, proved-in-service interest to the designer of pressure equipment as are the other engineering materials he may use.

Fluoroscopic Inspection of Light Metal Castings

by ROBERT TAYLOR

Consulting Radiologist, Pullman, Wash.

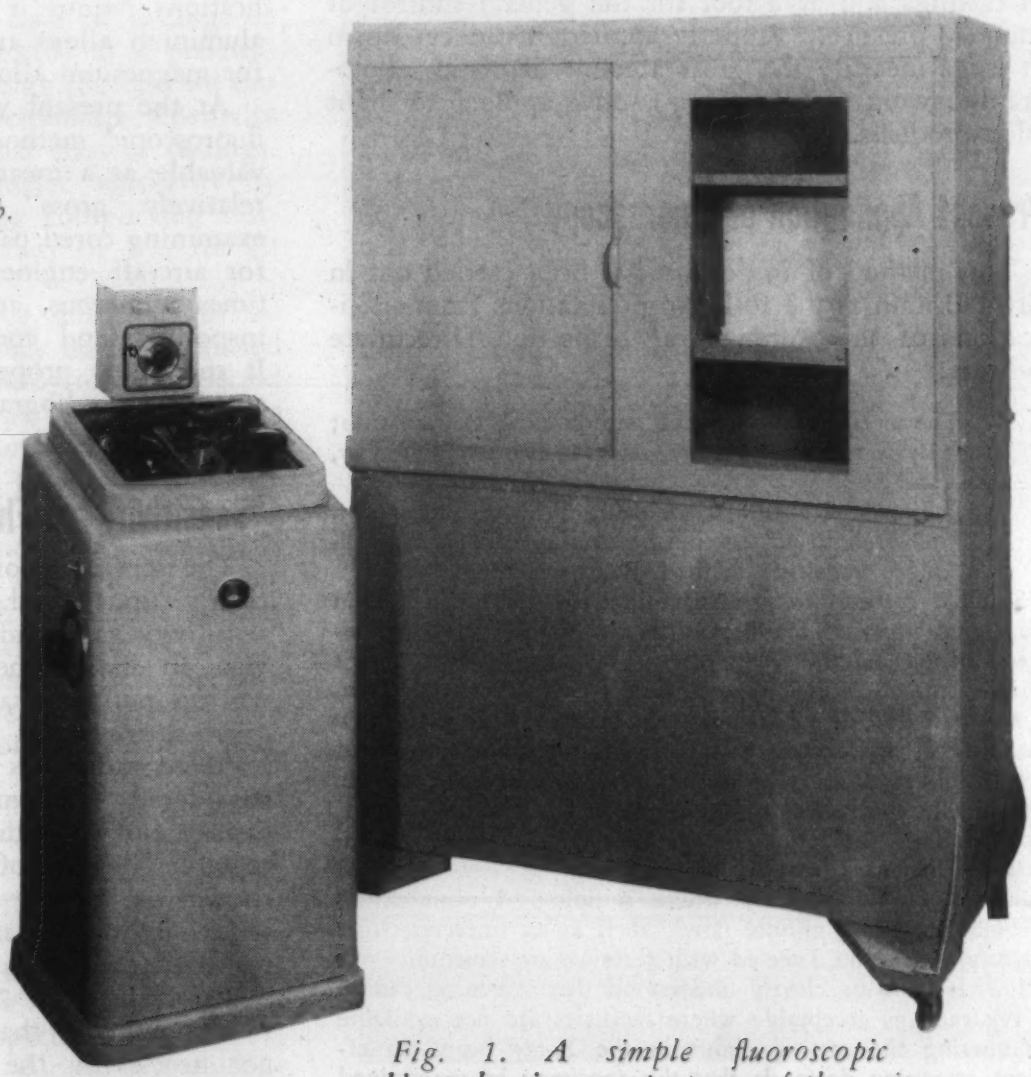


Fig. 1. A simple fluoroscopic cabinet showing compactness of the unit.

Inspection of light metal castings for internal flaws is conventionally done by radiography (X-ray photography). Increasing interest, however is being shown in visual examination (i.e. without a permanent photographic record) by X-rays, using a fluorescent screen. Called fluoroscopic inspection, this obviously rapid process is still technically inferior to radiography in "sensitivity," but has already demonstrated its usefulness for preselecting or sorting of castings to be radiographed. Specifications permitting its use for routine control inspection under prescribed conditions do not yet exist but may soon be issued, and in anticipation of that development a few commercial metal-fluoroscopy machines are now on the market. This article discusses the process, its applications and its limitations, and describes available equipment for its industrial use. —The Editors

THE USE OF FLUOROSCOPY (visual examination of the internal nature of an object on a fluorescent screen) for industrial X-ray inspection has generally been confined in this country to the examination of auto tires, packaged goods, citrus fruits and shoe-fittings. At the present time, however, considerable research is underway to establish the best operating conditions for the fluoroscopic inspection of aluminum and magnesium aircraft castings. These investigations should prove as fruitful for fluoroscopy as have analogous studies for radiography in recent years, whereby sensitivity has been improved, X-ray tube design bettered, electronic control applied and certain undesirable types of cassettes, holders, etc., eliminated.

In anticipation that specifications will soon be issued to include fluoroscopy for routine control in-

spection of certain types of castings, X-ray equipment manufacturers have designed and are now selling machines suitable for fluoroscopic inspection on one hand or through electronic attachments for optional fluoroscopic or radiographic examination, on the other; the latter type are conveyorized for high production requirements.

The fluoroscopic method is most useful as a method of "preselecting" castings, with relatively gross defects for subsequent radiographing. It is especially valuable for the inspection of cored passages in castings and as a tool for the general control of foundry practice. Properly applied it can cut down in large measure the great amount of X-ray photographic work (radiography) now applied to light alloy products.

Present Application of Fluoroscopy

This method of inspection has been carried out in Great Britain as the following quotations from specifications of the Aeronautical Inspection Directorate indicate:

> 21. There are two types of radiological examination;
> (a) By X-ray photography, referred to as radiography, and
> (b) By visual examination, using a fluorescent screen, referred to as screening. Radiography is a much more sensitive method than screening.
>
> Suitable castings may be examined by screening, within the limits imposed by their size and shape, and with regard to the suitability of the X-ray equipment. Light alloy castings having a maximum cross section of 2 in. in any part and of such shape that manipulation will allow the X-rays to penetrate each part of the specimen so that a readable shadow is produced on the fluorescent screen, are suitable specimens for examination by screening. Steels, copper alloys and other heavy metals are in general unsuitable for examination by screening. They must be examined radiographically where radiological examination is specified. Very minute flaws, such as an intercrystalline porosity, cannot be detected with certainty by screening.
>
> 23. It is to be clearly understood that screening cannot be regarded as acceptable where facilities are not available for moving the casting about in the X-ray beam, as efficient screening demands that the specimen be maintained in continuous movement while the fluorescent screen is carefully scrutinized. The specimen must be manipulated by the use of tongs or a remote handling device; the operator's hand must not be used for the purpose whether enclosed in a protective glove or not. Care is to be taken during screening that the area of the screen illuminated is not excessive.

An important factor which gave impetus to the designing of fluoroscopic machines has been the drain on film manufacturers during the War. Another factor for important consideration was the matter of economy of inspection concerned wherein with radiography the cost of film, processing solutions and operators' time all had to receive vital consideration.

In evaluating fluoroscopy, it is first essential that the sensitivity of the process be thoroughly and accurately determined. The standard sensitivity gage called the "penetrameter" required by the various Government agencies and committees to determine the degree of sensitivity present in any particular inspection procedure are quite satisfactory for use in visualizing the sensitivity of the fluorescent image.

One fact should be clearly understood at this point —*that fluoroscopy is not to be considered a substitute, but rather a supplement to radiography.*

As mentioned earlier, a sensitivity of from 3 to 5% and upwards, depending on the design and thickness of a casting, is possible in fluoroscopic inspection, whereas a 2% sensitivity is required in most specifications; for example, Army Air Forces specifications require a 2% penetrameter sensitivity for aluminum alloys and a 3% penetrameter sensitivity for magnesium alloys.

At the present writing, it would appear that the fluoroscopic method of inspection should be most valuable as a means for pre-selecting castings with relatively "gross" defects, and also as a means of examining cored passages in castings, especially those for aircraft engines wherein cored passages are at times numerous, and in the foundry as a tool for inspecting and controlling the foundry technique. It should, if properly applied, cut down the great amount of radiographic inspection being carried out on light alloys.

"Sensitivity" of Fluoroscopic Inspection

The sensitivity of a method or process should be clearly understood. The penetrameter acts as a sensitivity gage and is in fact a basic calibration device. In stating the penetrameter sensitivity at 2% we can not necessarily state that the sensitivity for micro-shrinkage is 2%. There are such factors as scattered radiations within a casting which must be considered. We might standardize on a particular casting and state that in this casting there is an acceptable degree of micro-shrinkage, produced or shown on a film or screen, with a penetrameter sensitivity of 2%, and in this we are safe in employing the technique used for the exposure of that particular casting for 2% sensitivity.

The point is that the penetrameter sensitivity is not necessarily the sensitivity of a particular discontinuity. It is, rather, the sensitivity that would be shown if a penetrameter wedge of the same alloy were radiographed or fluoroscoped with the same kilovoltage, milliamperage, focus-film distance and time of exposure. The sensitivity actually obtained is, as a rule, inferior to the penetrameter sensitivity, owing to the presence of scattered radiation and unfavorable overlapping of sections of the casting. For example if sections ½ in, and 1 in. in thickness overlap, the technique is required to give a penetrameter sensitivity for 1½ in., *i.e.,* capable of revealing a slot 0.03 in. deep, but this means no better than 6% in the 0.5-in. section and 3% in the 1-in. section. If there is considerable scattered radiation, the actual sensitivity obtained may be correspondingly worse.

The ability to discover a defect within a casting depends to a considerable extent on the shape and size of its image on the fluorescent screen, a fact that must be considered in stating the exact sensitivity of the method. Although the sensitivity ob-

tained with the penetrameter is the basic calibration factor, the characteristic differences in legibility of the images of various types of discontinuities must be considered in viewing the image. It might be a good starting practice to determine sensitivity by actual sectioning of a casting for visual inspection of actual faults and then determine the penetrameter sensitivity required to reveal each type of flaw.

For instance, the permissable degree of microshrinkage, as estimated by the microscope, having been prescribed for a particular class of castings of a particular alloy, might be detected at a penetrameter sensitivity of 3%. This being the case we can state with certainty that the penetrameter sensitivity must be established at 3% for that class of castings. If we can visualize a penetrameter sensitivity by fluoroscopy of 3% when viewing complicated castings, this should ensure a sensitivity of 5% for all parts of the casting.

A method for determining the sensitivity of an image on the fluorescent screen may be accomplished by building a step-tablet of the alloy to be inspected and graduating the tablet in steps of three, varying in thickness, say from 1/2 to 3/4 to 1 in., and then superposing over each thickness 5 penetrameters ranging from 2 to 10% in increments of 2%. By viewing the image on the screen the penetrameter sensitivity may be readily determined; for example, if we can perceive the 3% hole for each thickness we may state that our sensitivity for each thickness is 3%, as illustrated by the penetrameter. (Since the writing of this manuscript, such a penetrameter has been devised by Dr. S. W. Smith of Kelly-Koett Mfg. Co.)

Equipment Available

There are two types of fluoroscopic machines to be considered. First the simple fluoroscopic machine, designed solely for fluoroscopy and second the combination, conveyor fed machine designed for both fluoroscopic or radiographic inspection.

Fig. 1 illustrates the simple fluoroscopic cabinet, the details of which can be more readily understood from the drawing, Fig. 2. The cabinet is of all welded steel construction with the fluoroscopic chamber completely lead lined. In order that the observer be out of the path of the direct beam, a "periscope" principle is employed, using a 45-deg. front surface mirror which the observer views through a lead glass window. The fluoroscopic screen and mirror assembly are made into one unit with a lead glass front, gasketed so as to be dust proof and fume proof for protection of the mirror surface. A series of guides are arranged at 1-in. intervals and the screen and mirror assembly can rest on any chosen pair of guides.

The work to be fluoroscoped is placed on a bakelite shelf below the screen which fits on to the same series of guides as the screen and mirror assembly so that the shelf can be placed within 1 in. of the screen, or as close as the size of the casting permits. The lead glass window on the front of the cabinet is made large enough so that the operator can look

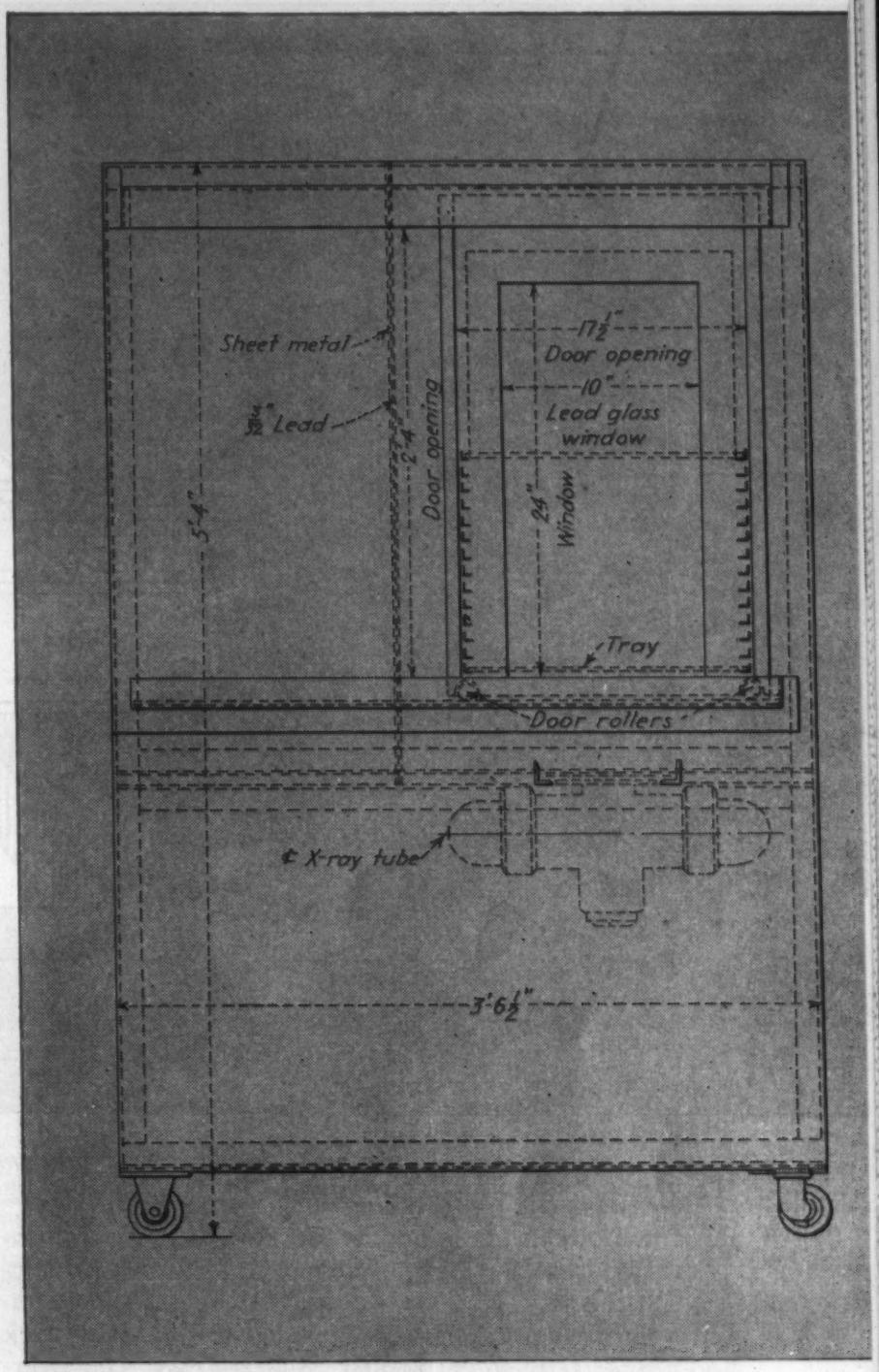


Fig. 2. Drawing of the fluorescent cabinet.

through it regardless of the height of the screen. This window is placed right in the access door which is mounted on rollers in such a fashion that it can be readily slid to one side. A safety switch insures that the X-rays are turned off as soon as the door is opened.

With this arrangement, the X-ray tube is below the screen which means that the parts are conveniently below eye level for easy replacement. In order to improve visibility by masking out the uncovered parts of the fluorescent screen that are not covered by the casting, there is built into the cabinet a manually adjustable lead shutter for control of the area of the screen to be viewed.

Details of the Conveyor Cabinet

The conveyor cabinet is essentially a line-production unit with built-in conveyor for continuous

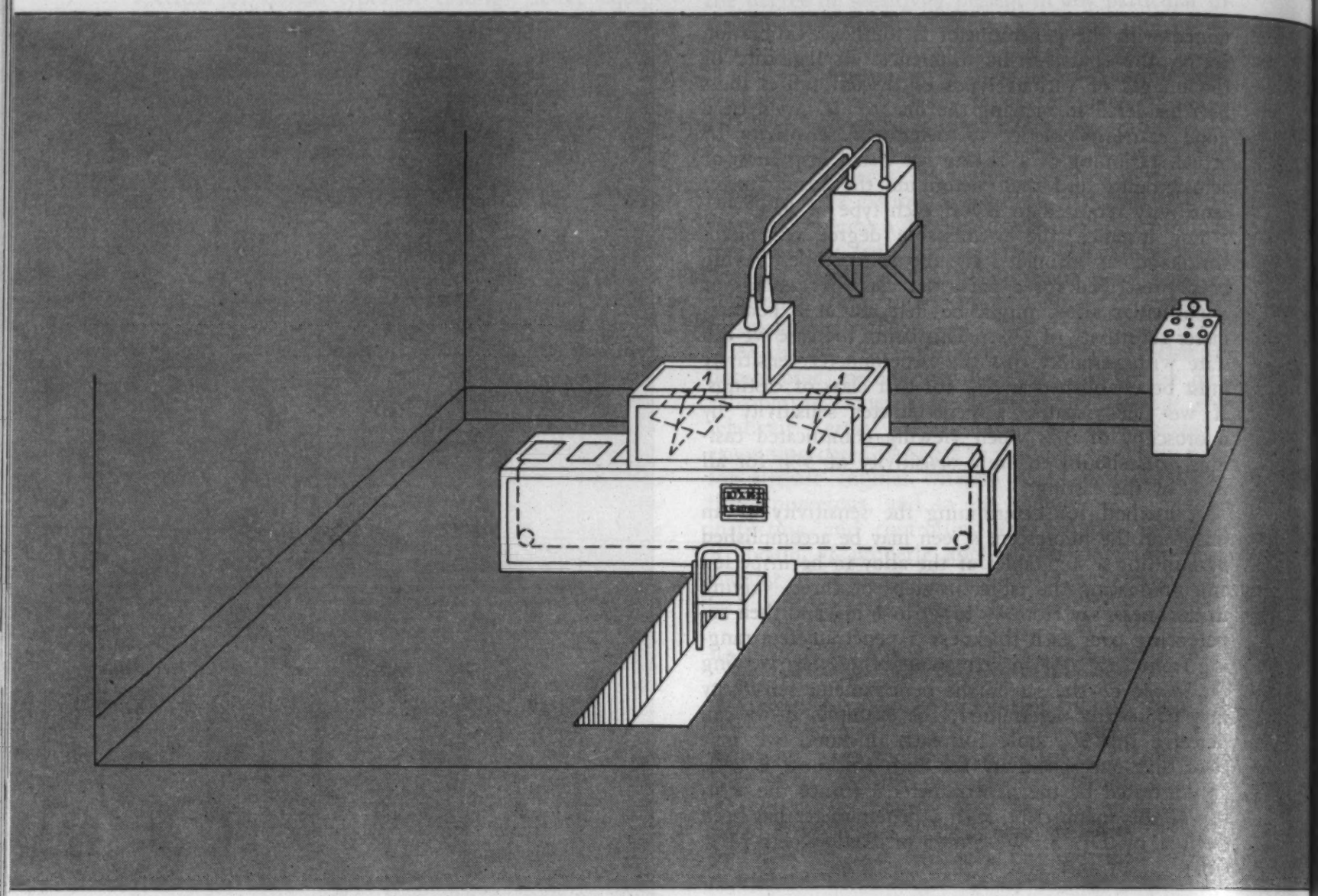


Fig. 3. Schematic drawing of conveyor fed, combination fluoroscopic-radiographic production machine.

fluoroscopy or radiography or both. It is so constructed that it can be integrated with any production line that may be in use. If required, a conveyor of this type can be extended through safe lock doors directly into the processing room. The overall dimensions are approximately 14 ft. 4 in. in length by 3 ft. 3 in. wide by 8 ft. high and is constructed of all-welded frame, the X-ray chamber being completely lead lined. The X-ray tube is at the top and is adjustable in height for any target-screen distance from 18 to 30 in. The tube is rigidly supported and the cables extend out from the top, using conventional "post-hole-digger" type of cable and which, if hand room is limited, may be reduced from the standard 4 ft. 2 in. length to as little as 14 in.

The conveyor embodies a series of bakelite trays, 23 altogether, suitable in size for a 10 by 12-in. film, the trays moving at approximately 8 ft. per min. The use of bakelite trays in lieu of a belt of canvas, leather or some other material, has many advantages, some of which are:

1. Any soft or fibrous material suitable for use as a belt will catch and hold particles of metal, dirt, dust etc., which would appear in the fluorescent screen as dark inclusions in the specimen being inspected. Bakelite with its smooth, hard surface will cast off most of such particles, and fine dust which may collect may be easily wiped off.

2. A worn or broken belt requiring replacement or repair would necessitate a complete shut-down of the unit. Similar damage to a bakelite tray can affect only one tray at any one time and replacement can be made during a normal shut down period, with continued operation in the meantime with a negligible loss in production rate.

The conveyor can move forward or in reverse and the fluoroscopic observer can move it in either direction or stop it at the command of a foot switch. If desired, additional switches can be connected so as to permit stoppage of the conveyor by other workmen assigned to loading or unloading the castings. The observer views the specimen much the same as in the simpler fluoroscopic machine described above.

The problem of adequately sealing with lead the openings at the end of the cabinet through which the conveyor passes was solved in a very ingenious manner. Within the cabinet are placed two paddle wheels, one for each end of the cabinet, each paddle being driven by the conveyor drive motor and consisting of four lead blades 15 in. long and 15 in. wide except at the end, which is narrowed sufficiently to pass between the two chains that comprise the conveyor drive. In any position of the paddles

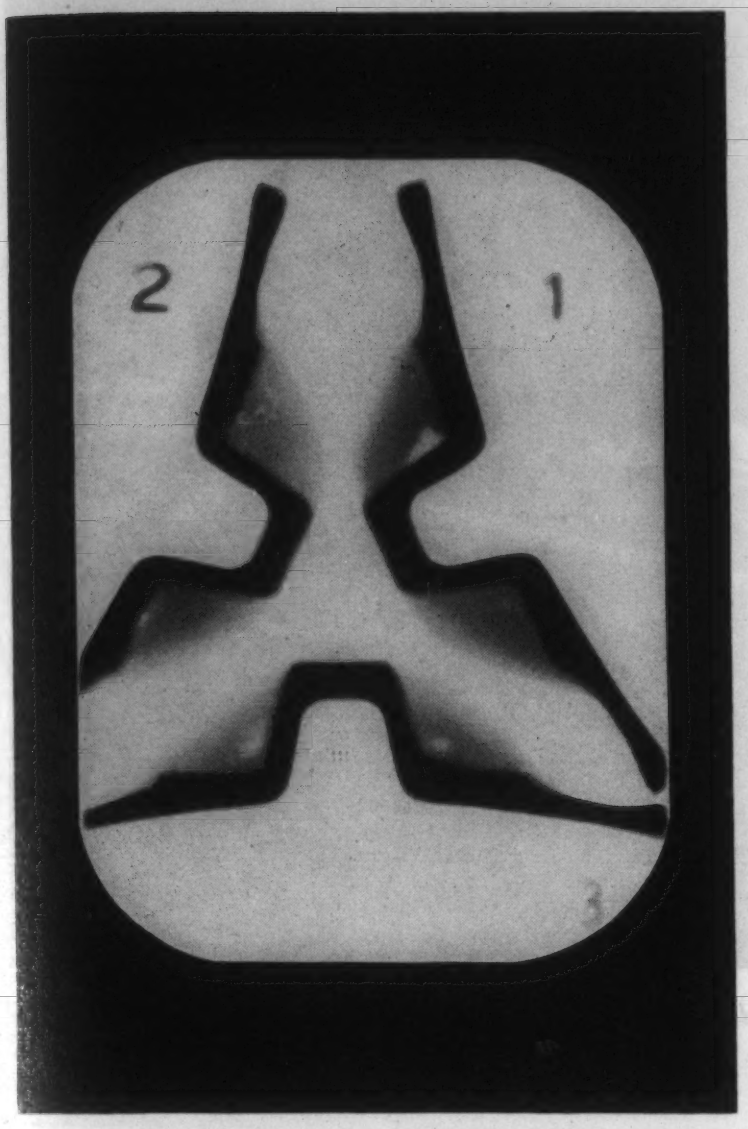


Fig. 4. Group of three castings positioned as for fluoroscopy in which the porosity and shrinkage was readily visualized.

there is complete obstruction to the passage of radiation to the outside of the cabinet, yet the blades themselves cannot interfere with the bakelite trays or with the specimens placed upon them.

The cabinet is also equipped with a manually adjusted lead shutter for diaphragming out the undesired beam of radiation, as explained in the description of the simple fluoroscopic machine.

In order that the trays be at a convenient height for loading, for example, 36 in. from the floor, the observer's chair should be set below floor level in a small pit. Normal eye level for a seated person is, as a rule 48 in. from the floor, and in order that the center of the mirror be at this height, the pit should be constructed 20 in. below floor level. It is suggested that the pit be equipped with a hinged tray door that can be dropped into a covering position when fluoroscopy is not being carried on so as to have this portion of the floor covered when radiographic inspection is being carried out.

Arrangements should be made for handling the specimens with tongs in order to view all sections of a casting and this may be accomplished by including a small door at the side of the mirror, wherein the operator with the use of tongs can adjust the specimen to any desired position. This has been accomplished for the combination machine but has been omitted from the drawing.

Operators performing fluoroscopic inspection should remain at this work for a period not to exceed 2 hrs. after which a relief operator should be assigned. A rest of an hour is sufficient for an operator to return to his screen viewing.

The value of fluoroscopy in certain classes of X-ray inspection should not be underestimated. It has been carried out abroad with success and there is little doubt but that it will find a place as a valuable adjunct to radiography in the inspection of materials.

Grateful acknowledgement is extended both The Kelly-Koett Mfg. Co., Inc., of Covington, Ky., and to the R. P. Kincheloe Co. of Dallas, Texas, for the illustrations of the machine. The machines described are a product of Kelly-Koett; other X-ray equipment manufacturers also make fluoroscopy machines and fluoroscopic-radiographic combinations.

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Fig. 5. Large blow-holes (gas) in aluminum alloy sand casting easily visualized on the fluoroscopic screen.

Sand mold ready for closing before pouring.

Risering of Steel Castings

—GRAPHITE RODS IN BLIND RISERS

by JOHN W. JUPPENLATZ

Chief Metallurgist, Lebanon Steel Foundry, Lebanon, Pa.

During the last few years a new practice has been rapidly growing in use for the manufacture of sounder steel castings with considerable reduction in waste metal. The method, technically known as "atmospheric pressure feeding," involves the use of blind risers and some means such as graphite rods inserted in the latter for keeping the risers open to the atmosphere during solidification. This article explains the principle involved, describes the use of graphite rods and demonstrates how this practice localizes the shrinkage cavity and improves the general quality of steel castings. —*The Editors*

SUCCESS OR FAILURE in producing steel castings depends on several things, none of which is more important than proper use of gates and risers. Not only do correctly designed gates and risers determine to a considerable extent the quality of the casting produced, but also appreciably affect its cost. As a consequence any changes and improvements in the use of the gates and risers are of great importance to the steel foundry industry.

The most effective and economical method of feeding steel castings depends entirely upon a thorough knowledge of the principles of directional solidifi-

cation, using the advantages that may be gained from differential thermal gradients and application of atmospheric pressure. Directional solidification involves the controlled speeding of solidification in some regions and the retarding thereof in others by various means, so that the inevitable shrinkage cavity will occur in the top of a riser and not in the casting itself.

The fundamental researches on controlled directional solidification were conducted by Batty[1], and later by Briggs and Gezelius.[2] While technical literature prior to 1942 contains no reference to the function of atmospheric pressure on risers, H. D. Phillips[3] recognized its value in promoting soundness with open top risers, and this recognition prompted the development of methods of applying atmospheric pressure to blind risers as early as 1933. In 1942 Taylor & Rominski[4] presented a paper covering the use of blind risers and controlled application of atmospheric pressure.

Since the publication of Taylor and Rominski's work, considerable interest has been evidenced among foundrymen in the use of blind risers for steel castings and researches have been conducted on this subject with excellent results.[5]

The Shrinkage Cavity and Riser Types

Like most metals, steel castings undergo a shrinkage in volume during their solidification, and the void or cavity so created usually occurs inside the casting, because the skin of the casting next to the cold sand mold freezes first and fixes the outside dimensions. To prevent this shrink, provision is ordinarily made to feed the casting during solidification with molten metal from outside the casting, using for this purpose one or more large risers or heads connected with the mold cavity of the casting

The metal in these risers remains liquid for a longer time than that in the casting itself and thus can flow into the casting to fill the shrinkage void. Flow may occur through simple gravity if the riser is on a higher level than the top of the casting and/or by virtue of the difference between atmospheric pressure and the vacuum of the void.

When these risers extend to the top of the mold and are open to the atmosphere they are known as open risers or heads. Such risers must be relatively large in section and often in height to prevent premature freezing at the top, which would defeat the purpose of the riser. Of the total metal poured into a mold, often no more than 30 per cent is found in the finished casting, the remainder being in the heads, gates, and risers.

Where the part of the casting to be fed is located so low in the mold that an excessively long open riser would be needed, a blind head or riser may be used. A blind riser is one located entirely in the interior of the mold and covered by the mold sand (except for a small metal-overflow vent leading from the dome of the riser to the top of the mold). Blind risers have in the past been a problem not only because of the absence of any gravity feeding effect on the casting proper, but chiefly because the molten metal in contact with the sand roof of the riser solidifies (just as it does all along the surface of the casting) to form an airtight skin. This solid metal shell prevents atmospheric pressure from forcing the still-liquid metal into the shrinkage vacuum and the casting is likely to be unsound.

To overcome this and thus use the obvious metal-saving advantages of low-placed blind risers, the riser may be vented by inserting through the mold above the riser and well into the molten metal in it a wedge or rod of some permeable material that will (a) reach through and well below the solid skin of

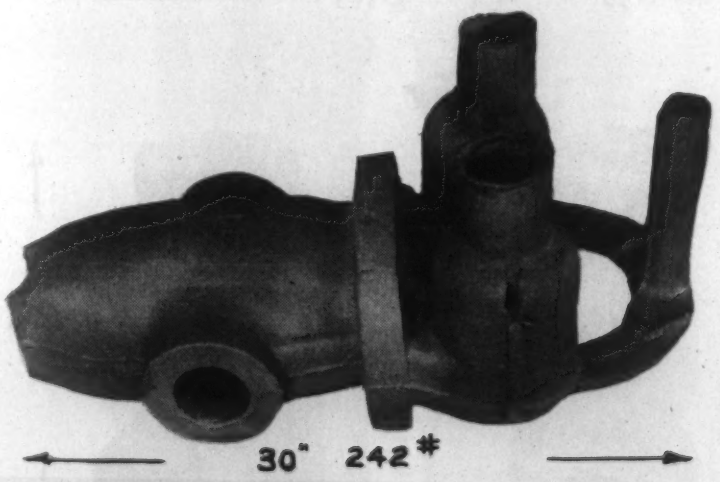

Fig. 1. Here is shown a pressure casting, using semi-blind risers, with the riser adequately attached to the heaviest section. Note how the principle of thermal gradients is used by gating into the risers to provide a volume of liquid feed metal sufficient for casting demand. Also notice the location of the atmospheric graphite core extending through the upper section of the riser, now indicated by an open hole, which contributes toward the efficiency of the riser.

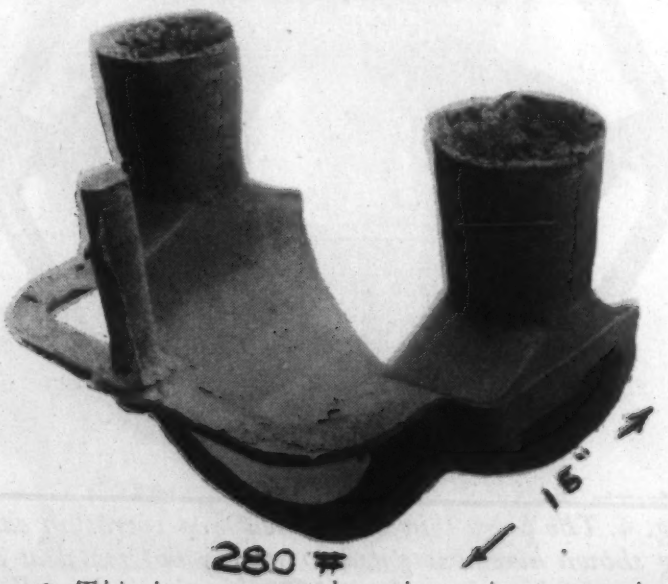

Fig. 2. This is a structural casting using open risers. The advantages offered by thermal gradients and directional solidification have been obtained through padding. These risers have been treated with carbonaceous material for efficiency as well as to maintain liquid feed metal for the casting demand under atmospheric pressure.

frozen metal at the mold surface and thus be in contact with the molten metal in the casting and (b) permit by its permeability the transmission of atmospheric pressure to the molten metal in contact with it. These permeable rods may be made of core sand or of graphite, the latter being a relatively recent development with certain demonstrable advantages over sand for this purpose, as we shall see.

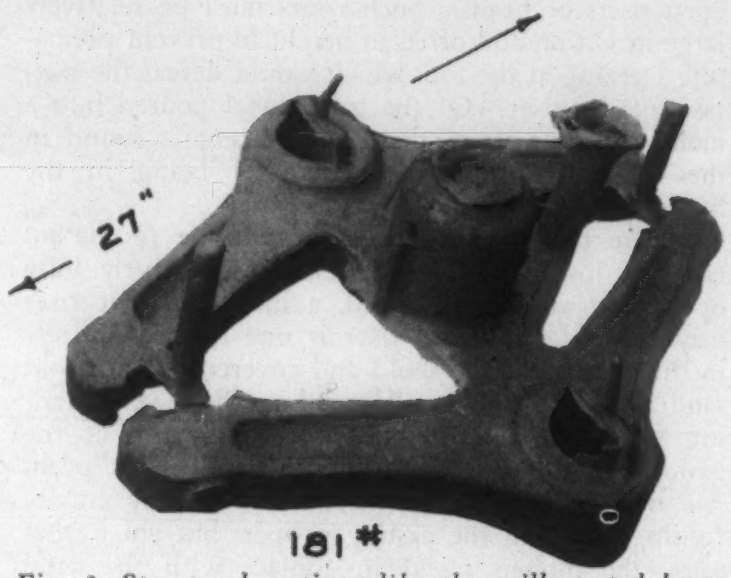

Fig. 3. Structural castings like those illustrated here, may be made in duplicate with a central semi-blind riser and gate. The riser is placed on the heaviest section with adequate directional solidification and thermal gradients provided by tapering the wall design for complete solidity. (The extreme ends were externally chilled. Note the method used in venting the mold.)

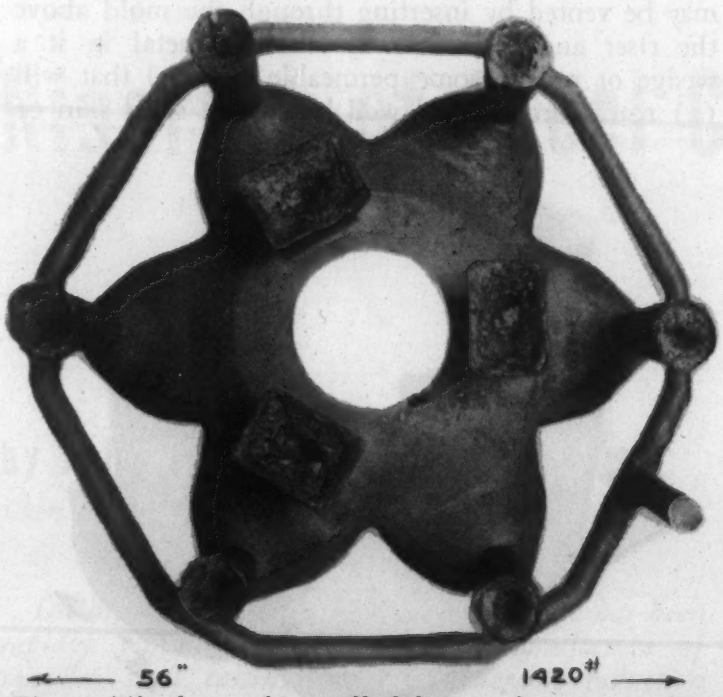

Fig. 4. The large thin-walled heat and corrosion casting shown here was gated to supply hot metal at all extreme points throughout 360° for thermal gradient advantages. At each point of gate contact a small open riser is provided. Larger open risers are provided in the upper, heavier wall sections. All the risers have been treated with non-carbonaceous material to provide efficiency and atmospheric pressure; the gate remains solid, having received no treatment.

The use of graphite rods is the result of research and development conducted by the Lebanon Steel Foundry and the National Carbon Co. in an effort to improve the efficiency of blind risers.

The semi-blind riser, finally, is a blind riser having a very large diameter vent leading from the dome of the riser to the top of the mold. The hole is too large in section to freeze entirely across during solidification and hence the molten metal in the riser is affected by atmospheric pressure, with the added advantage of an extra head of liquid metal to help fill the shrink. A semi-blind riser is really a blind riser surmounted by a small open riser.

Principles of Good Risering

Reducing all this to its simplest form, therefore, we may briefly state some of the practical, fundamental requirements of risering as follows:

1. The riser should be attached to the heaviest casting section.
2. The riser should be of such volume as to supply the complete demand of the solidifying casting for liquid steel and should contain the last metal to solidify.
3. The contact of the riser to the casting should be ample to enable delivery of liquid metal to the full demand of the casting.
4. The riser should contain the hottest metal in terms of superheat. This may be obtained by gating into the riser or by other means.
5. The riser should be constructed or treated so as to remain open (liquid) to the atmosphere until solidification is completed.

In order to apply the foregoing requirements to actual casting production, either open or blind risers or their combination may be used, according to the particular job, with gating being applied in various ways to obtain the advantages available through heat differentials and directional solidification.

All these requirements are well known to foundry engineers and are given due consideration in de-

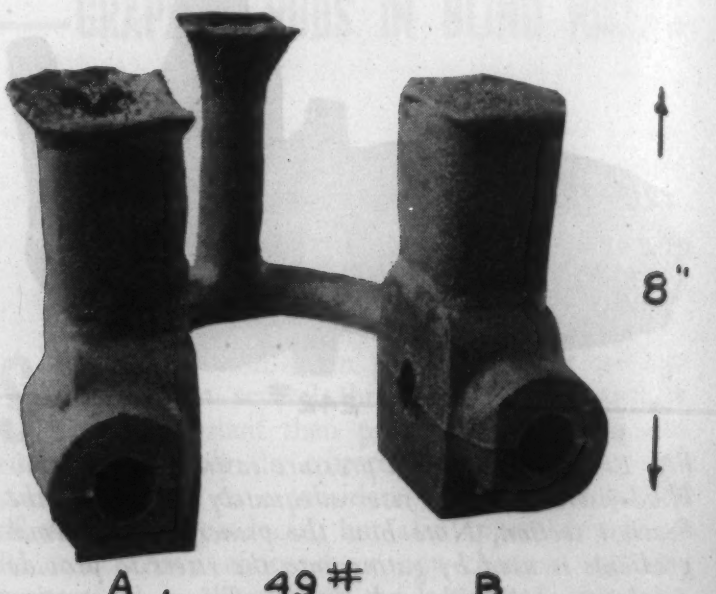

Fig. 5. This shows the method of risering and gating the sectioned casting illustrated in Fig. 5a. Casting A riser has received treatment whereas riser B has been permitted to freeze over and completely seal.

signing the castings and the molds in which the metal is cast. No. 5 particularly is constantly in the thoughts of foundrymen, for it offers many possibilities for securing better results. In applying requirement No. 5, metal additions are made to the risers, pipe dope is added to the riser surface, sand core rods are so placed in the risers to allow atmospheric pressure to be transmitted to the fluid metal in the riser and, more recently, the new method of attaining better results previously mentioned has been tried.

This method consists of mounting in the risers small graphite rods so placed that the rising metal completely surrounds them. As a consequence the freezing temperature of the metal is lowered by the absorption of carbon from the graphite rods and the temperature of the metal is raised by the combustion of some of the graphite, both effects adding to the fluidity of the riser metal. In blind and semi-blind risers the graphite rods so burn out that holes are left in the side walls of the riser; atmospheric pressure may thus be transmitted to fluid metal through them as well as through the "pop off" which generally remains open as a result of the increased temperature within the riser cavity.

Some variations of risering and gating arrangements in practical use are shown by several accompanying illustrations (Figs. 1 to 6).

Using the Graphite Rods

The results shown in Figs. 6c and 6d are typical of applications using blind riser technique with the graphite rod. Some types of carbon rod compositions

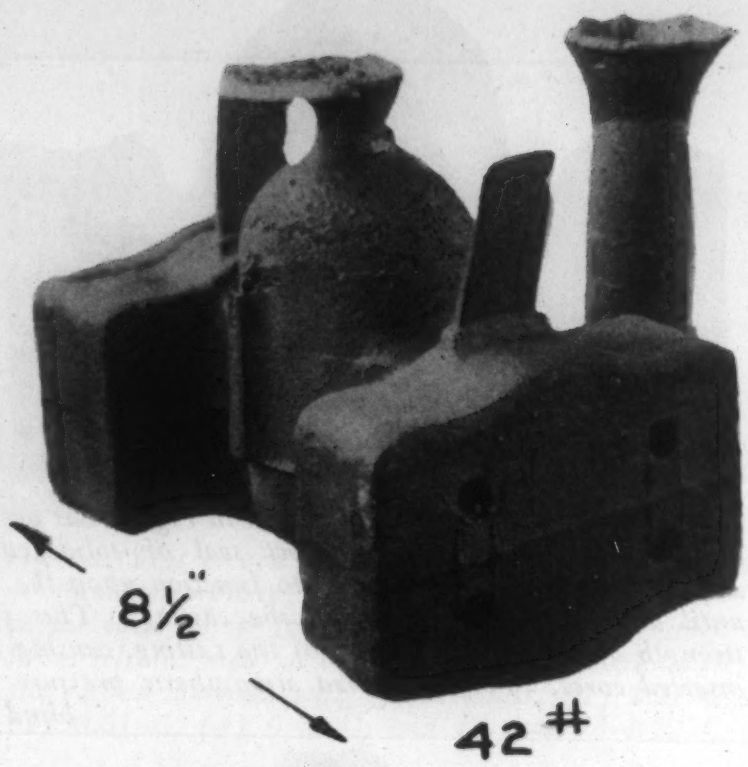

Fig. 6. This photo shows the method of risering and gating of the subsequent series of sectioned castings, using variations of atmospheric pressure and atmospheric cores. The castings are of simple massive shape with small angular cores which do not internally meet each other. The gate enters the riser for thermal gradients. Small flat vents are provided on the casting to relieve gas mold pressures. All castings were poured from the same heat at 2890 F.

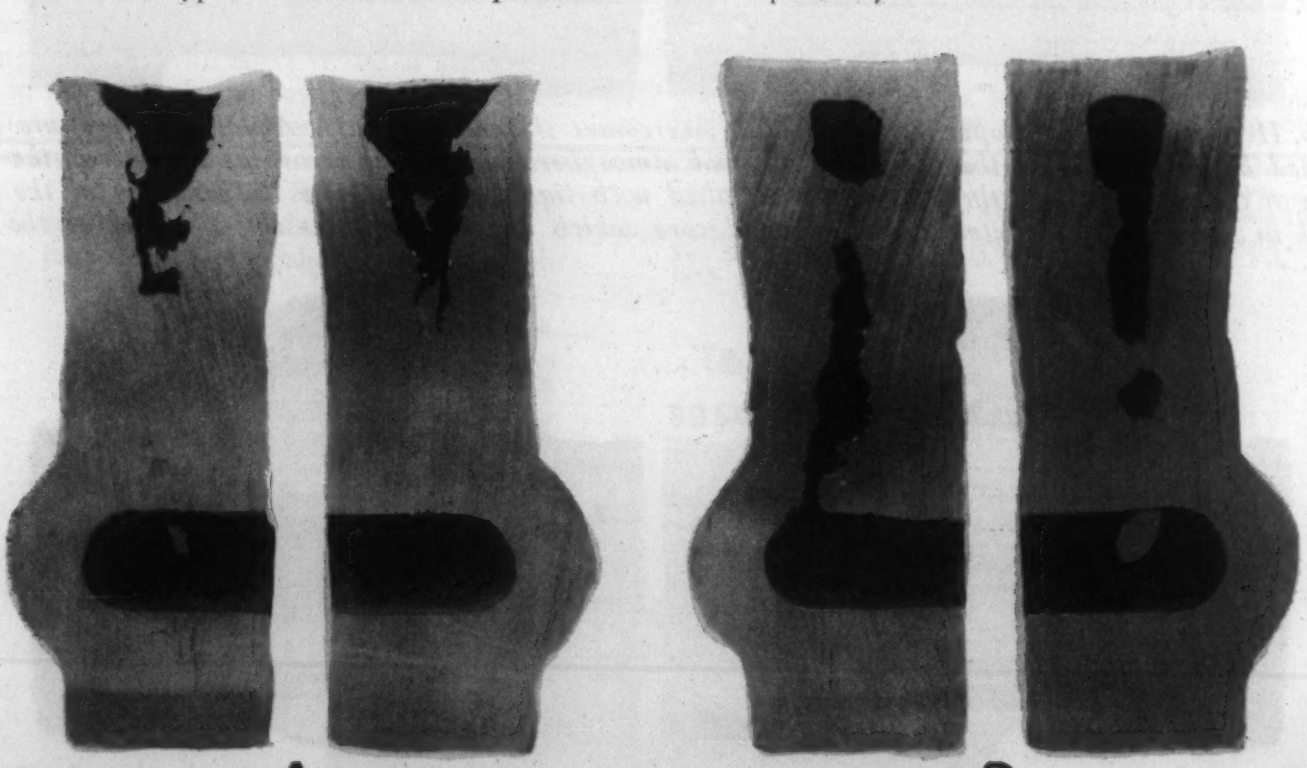

Fig. 5a. The castings of Fig. 5 were cross sectioned to show the effect of treatment. Sections A exemplify the normal type of shrinkage when treated with carbonaceous material, permitting the full functioning of atmospheric pressure. Sections B, a duplicate casting, did not receive such treatment. The shrinkage vacuum in B coupled with atmospheric pressure sought out the weakest and hottest point of skin formation, which proved to be at the internal core, resulting in a shrinkage cavity within the casting itself. Actually this process, in which the casting feeds the riser, is in reverse of normal, because atmospheric pressure is exerted through the casting proper. Its potent strength should not be underestimated.

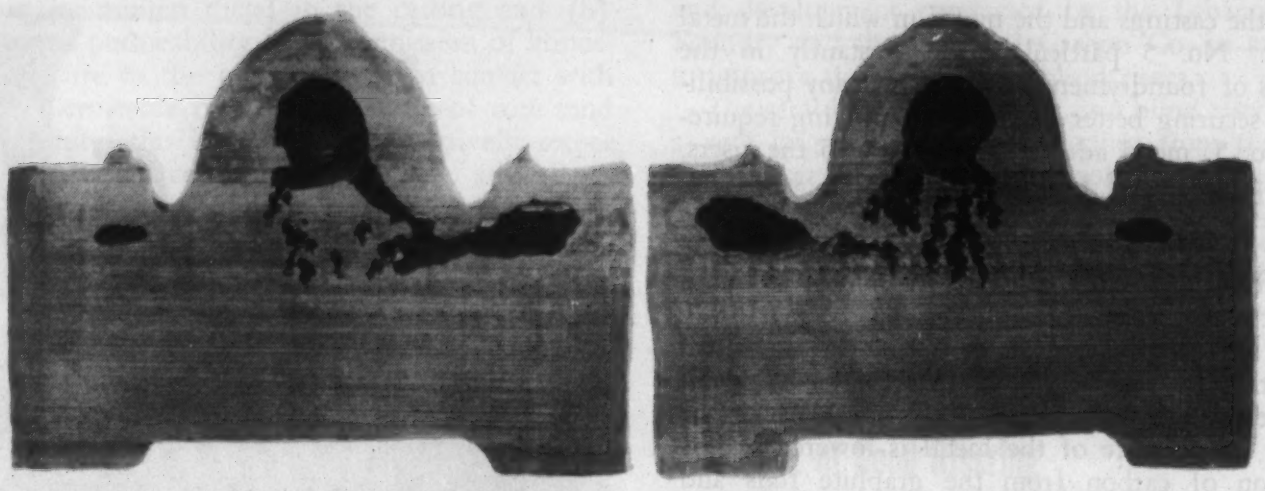

Fig. 6a. This casting, made as shown in Fig. 6, has been purposely made with a blind riser without the use of atmospheric pressure. A perfect seal of solidified metal has been formed over the riser, and therefore atmospheric pressure has failed to function upon the riser. Solidification progressed in a normal manner until a vacuum formed within the casting. This force upon continued solidification, exceeded the hot-strength of the hottest portion of the casting, causing a collapse or break in the casting wall within the small inserted cores. This permitted atmospheric pressure to exert its full powers, so the casting actually fed the blind riser.

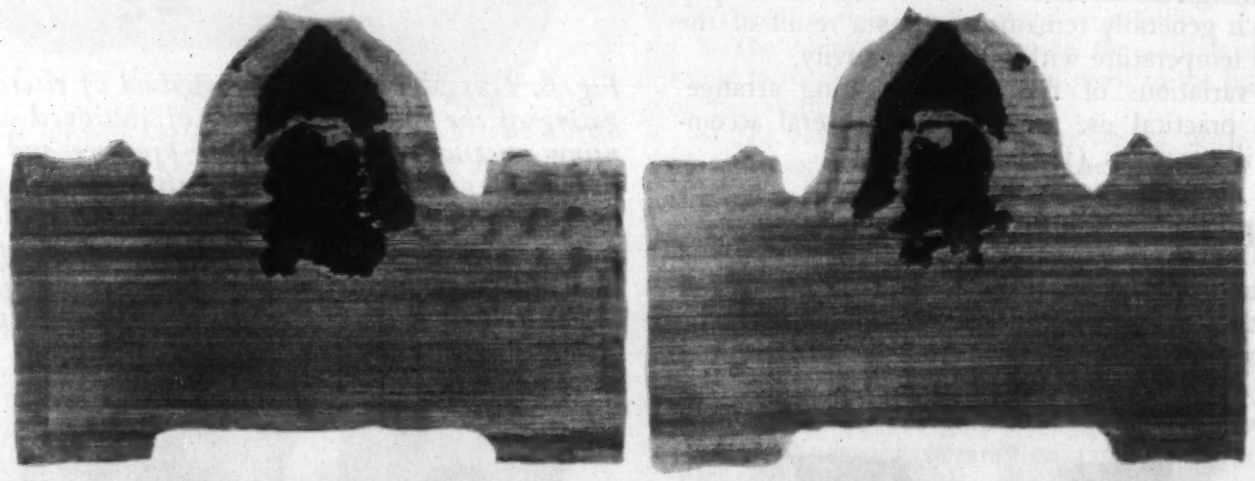

Fig. 6b. Here we see how proper technique easily overcomes shrinkage defects. Atmospheric pressure is not restrained but is assured by the use of an oil-sand atmospheric core placed across the diameter of the upper portion of the riser. The castings are amply supplied with liquid metal. Note the tendency of the metal to chill in areas about the atmospheric oil-sand core which definitely reduces the efficiency of the riser.

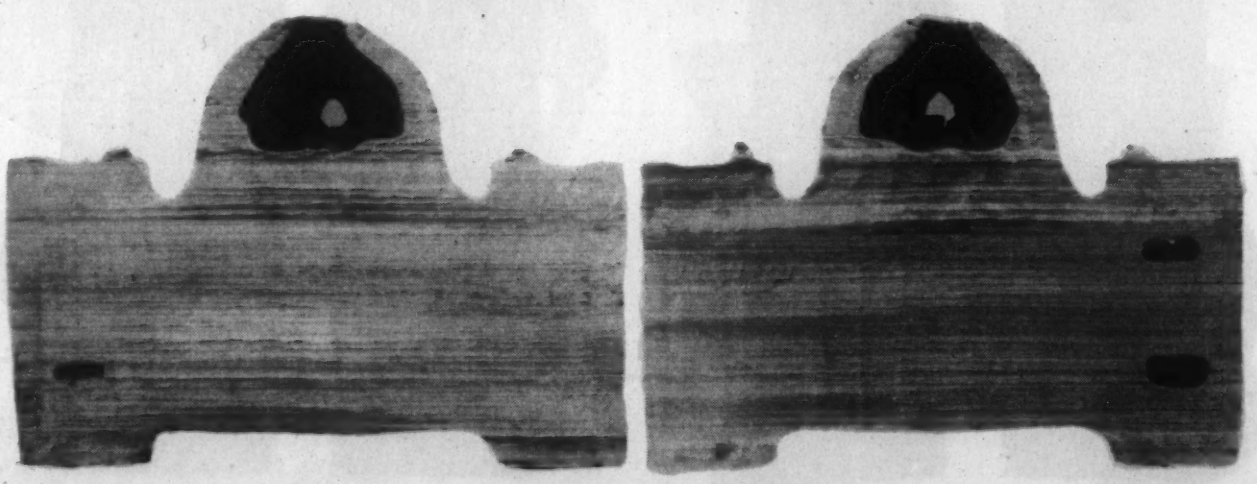

Fig. 6c. Here is shown the result of using a graphite rod in place of the conventional oil-sand core. The shrinkage cavity is noticeably flat bottomed compared with those in Figs. 6a and 6b and is confined to the upper portion of the riser, denoting better efficiency. Frequently, as a result, the riser height can be reduced and often the size of the runner can be reduced also. This is due to the absorption of carbon into the liquid steel from the graphite rod, thereby lowering its freezing point. A 1.00% C increase is equivalent to about 120 F. lowering of freezing point. Longer time of solidification within the riser permits atmospheric pressure to more effectively exert its power before complete solidification. Also some heat is gained within the riser due to the carbon and oxygen exothermic reaction.

seem to be more effective and more soluble in molten steel than others. For example, graphite is more effective than carbon for equivalent weight.

It might be expected that square rods with larger surfaces and sharp corners would be more effective than round ones of equivalent diameter but such has not proved to be the case. The degree of porosity of the material likewise seems to be an ineffective characteristic, for variation in porosity in a range of 1 to 30 did not change the results. Presumably, regular graphite is porous enough to transmit atmospheric pressure as required.

Excessive size of rods in relation to the riser dimensions, or an insufficient reservoir of molten feed metal will easily result in excessive carbon contamination of the casting proper. A practical relation of graphite rod and riser diameter is considered to be as follows:

Riser Diameter	*Graphite Rod Diameter*
3 to 5 in.	1/4 in.
5 to 8 in.	5/16 in.
8 to 12 in.	3/8 in.

Various designs submitted for steel castings often present problems in locating risers, gates and even external chills. Careful study may show that combinations of open and blind risers can be employed (see Fig. 7) to considerable advantage. The placement of risers and gates must also be fully considered from the standpoint of production economy so that they may be removed without excessive difficulty. Padding or modification of design often will promote soundness when other methods fail.

Assuming good foundry practice otherwise, full consideration of directional solidification and differential thermal gradients in the planning of risering and gating, together with effective use of atmospheric pressure in the risers, is the best assurance of soundness and metal economy in steel castings.

The technique of using a vented blind riser is only about 4 yrs. old but has found wide acceptance in the foundry field. By this practice, a vast improvement has been accomplished in those applications where blind heads (not vented) had heretofore been used of necessity. It has also frequently supplanted the use of open risers, especially where the complexity of the casting requires multiple heads. This has been due to a permissible decrease in head size, thereby decreasing the amount of pouring metal required. The size of runner from riser to casting has also been decreased, thus reducing cutting and grinding costs to produce the finished casting.

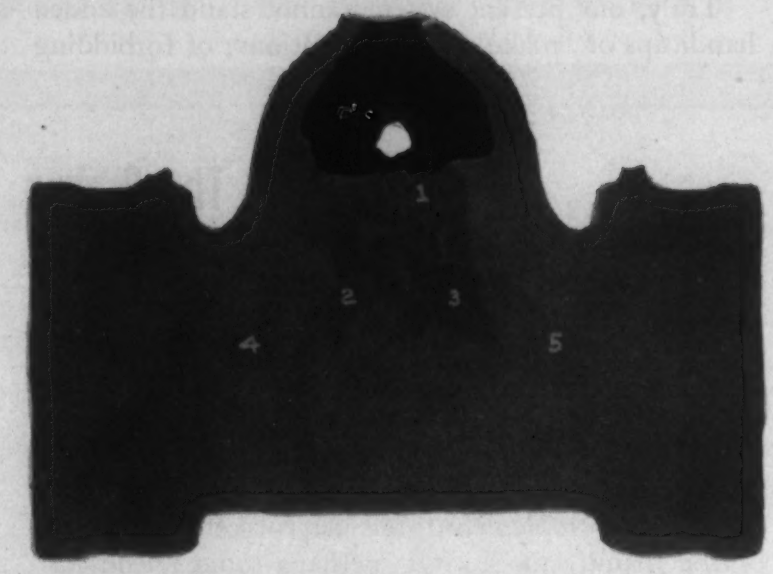

Fig. 6d. This etched section (etched with 15% ammonium persulphate) of the Fig. 6c casting and riser shows increase in the carbon content of the steel. From selected areas as indicated, drillings were taken for carbon analysis, with these results: (1) 2.27 C, (2) 0.67 C, (3) 0.42 C, and (4 and 5) 0.12 C.

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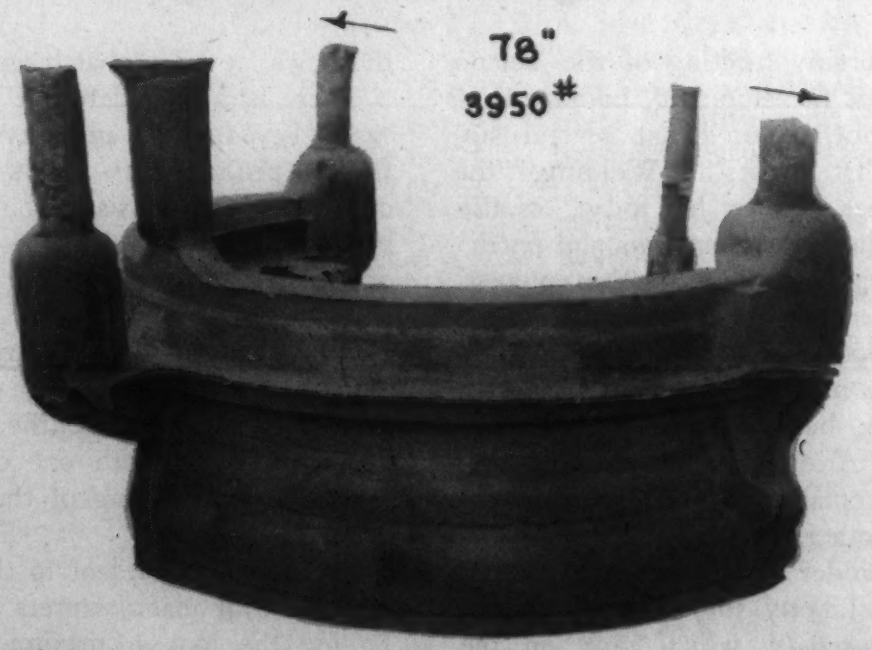


Fig. 7. An example of the use of a combination of open and blind risers.

(Continued from page 849)

Truly, our present system cannot stand the added handicaps of "make work" regulations; of forbidding the use of high production tools because they may reduce the number of jobs; or of any of the swarm of regulations which increase costs without showing a compensating increase in output. —K. R.

The Orphan Trade Name

Brand or trade names of certain proprietary metals and alloys often — like a tiny tot at Coney Island — get lost and separated from their parents. At times a fair percentage of the telephone calls that come into our office from persons seeking information is of the following type: "What company makes 'Hitensil'?"

It seems that the inquirer has been using "Hitensil" and wants to replenish it, but has forgotten the name of the manufacturer. Or, perhaps some friend has recommended "Hitensil" or a British principal has asked his American agent to ship it under a war priority — yet no one knows its source of supply.

It so happens that we have numerous catalogs, handbooks and directories and perhaps 75 per cent of the time we can identify the parent. But too often we fail. In some instances the parents have died through bankruptcy or otherwise and "Hitensil" is in reality an orphan, but we have no vital statistics to show such death, nor data to correlate "Hitensil" with the deceased parent.

We believe that advertising departments should exert more effort to so label their brain childs that they will not lose their identity. To take an example outside the metals fields, to us "Socony" is the perfect trade name because it readily identifies the child.

Let the firm emboss his company name as well as the pet trade name upon his product, be it electrode, ingot or tubing. Undoubtedly most companies already do this.

The ideal situation, perhaps, would be to designate all metals by numbers and initials, such as the SAE or NE steel series. This would mean of course that proud parents would have to swallow their pride and regiment their children. But this tendency may already be well under way. Thus in a recent house organ of Ampco Metal, Inc. it is stated:

"Back in 1915 Ampco was a 'secret metal.' The chemical composition was decidedly hush hush. There was no reference to aluminum and iron content. It was 'a bronze of at least 80% copper.' The secret was safely sealed and deposited in a safety deposit vault. Today catalogs and bulletins boldly list the principal ingredients."

Prior to Pearl Harbor there was a move started to standardize on steels and compositions, even though it stepped on the toes of manufacturers who had spent much to build up a trade name.

Perhaps brand names are proving a relic of more romantic and glamorous days of the metal industries. Remember when gas-awful blast furnaces were named "Annie," "Grace" and "Josephine"?

Will the hard, cold practical facts of a war situation do away with much of this naming process which borders on nonsense?

—H. A. K.

Making the Most of Welding

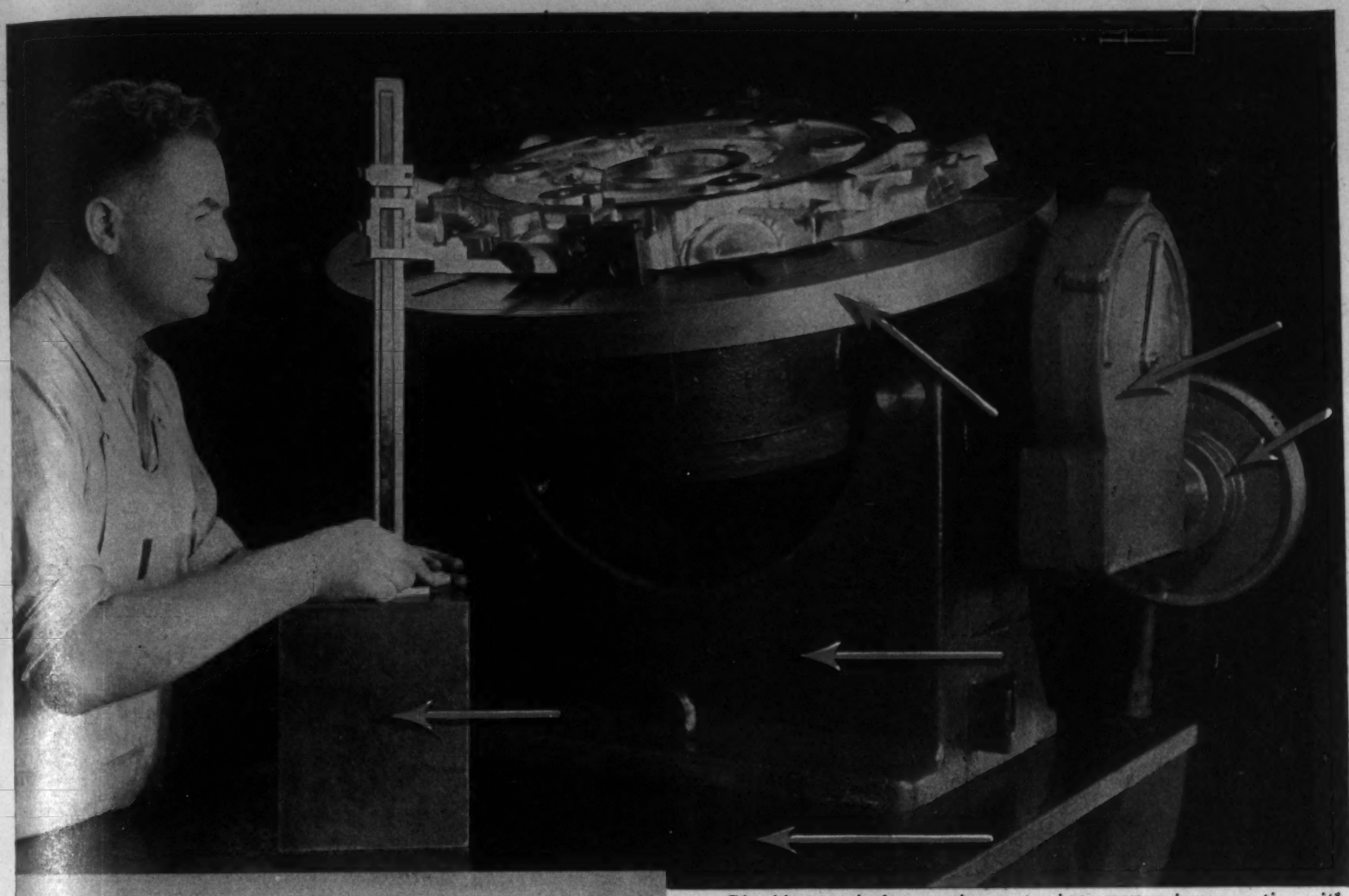
Speaking at the February meeting of the Toledo Committee for Economic Development, Lorenzo Kinnon, welding consultant, pointed out several significant facts about that process. Welding, "the most important tool that industry has today," is also the most regulated. There are more laws and restrictions about welding than about any other process. The aircraft industry was at first limited to gas welding. The Navy looked askance at the method until the German navy made use of it in its pocket battleships. Even now, he said, regulations in aircraft welding for the Army and Navy are so different that a weld acceptable to one service might be condemned by the other.

Welding has been under fire in connection with the sinking of several Liberty ships. Mr. Kinnon, speaking of the *Schenectady,* which sank on the West Coast, said, "Welding was not the cause of failure of the *Schenectady.*" He was a member of the investigating boards in several of the sinkings, he said, and the failures all started at a point near the bows, at No. 3 hatch, and continued back.

There had been defective welding in some shipyards, he admitted, and eleven welders are now in federal penitentiaries for it. These welders, paid on a lineal foot basis, had increased their earnings by doing "bridge welding" — building up the face of the weld without filling in the root properly. Even as he was speaking, a welder in Brooklyn Navy Yard was being charged with sabotage for the same sort of welding on the superbattleship *Missouri.* In this case the weld was made at a point directly beneath one of the 16-in. gun turrets, so that the firing of the guns might have destroyed the ship.

The greatest retardant to the use of welding was the failure of manufacturers to design for welding. To use the tool at maximum efficiency the work should be designed especially for such construction, to reduce the amount of welding necessary, to eliminate or minimize locked-up stresses, and to permit of welding in the most favorable positions.—K. R.

IN NEW PRODUCT DESIGN...



Checking an airplane engine part using a ROTAB *in connection with Meehanite cube and surface plate.*

MEEHANITE FOUNDRIES
Ready to Serve You – NOW

Allentown, Pa.	*Traylor Engineering Company*
Ansonia, Conn.	*Farrel-Birmingham Co., Inc.*
Birmingham, Ala.	*Continental Gin Co.*
Bridgewater, Mass.	*The Henry Perkins Co.*
Brooklyn, New York	*E. W. Bliss Company*
Buffalo, N. Y.	*Pohlman Foundry Co., Inc.*
Charleston, W. Va.	*Kanawha Manufacturing Co.*
Chattanooga, Tenn.	*Ross-Meehan Foundries*
Chicago, Ill.	*Greenlee Foundry Company*
Cincinnati, Ohio	*Cincinnati Grinders Incorporated*
Cincinnati, Ohio	*The Cincinnati Milling Machine Co.*
Cleveland, Ohio	*Fulton Foundry & Machine Co.*
Denver, Colo.	*The Stearns-Roger Mfg. Co.*
Detroit, Mich.	*Atlas Foundry Co.*
Flint, Mich.	*General Foundry & Mfg. Co.*
Hamilton, Ohio	*The Hamilton Foundry & Machine Co.*
Hamilton, Ontario	*Otis-Fensom Elevator Co., Ltd.*
Irvington, N. J.	*Barnett Foundry & Machine Co.*
Jeannette, Pa.	*Elliott Company*
Los Angeles, Calif.	*Kinney Iron Works*
Milwaukee, Wis.	*Koehring Company*
Mt. Vernon, O., Grove City, Pa.	*Cooper-Bessemer Corporation*
New York, N. Y., Mawah, N. J.	*The American Brake Shoe Co.*
Oakland, Calif.	*Vulcan Foundry Company*
Orillia, Ontario	*E. Long, Ltd.*
Philadelphia, Pa.	*H. W. Butterworth & Sons Co.*
Philadelphia, Pa.	*Florence Pipe Foundry & Machine Co.* (R. D. Wood Company, Selling Agents)
Phillipsburg, N. J.	*Warren Foundry & Pipe Corp.*
Pittsburgh, Pa.	*Rosedale Foundry & Machine Co.*
Portland, Oregon	*Crawford & Doherty Foundry Co.*
Rochester, N. Y.	*American Laundry Machinery Co.*
St. Louis, Mo.	*Banner Iron Works*
St. Paul, Minn.	*Valley Iron Works*
Seattle, Washington	*Washington Iron Works*
Spokane, Washington	*Washington Machinery & Supply Co.*

THE TREND IS TO
MEEHANITE

A *new* development engineered and designed by Machine Products Corp., Detroit, is ROTAB, a flexible machining and checking device which permits complete machining or checking of all angles of a unit without disturbing the original clamped position.

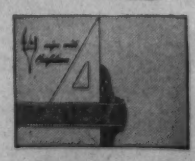
When designing this equipment only Meehanite castings were considered because in Meehanite each design factor is known dependable and uniform. Modulus of elasticity, tensile strength (up to 55,000 lb. p.s.i. as cast) transverse strength, impact values, —all have been established by test, proved in service, and assured during manufacture by Meehanite process controls.

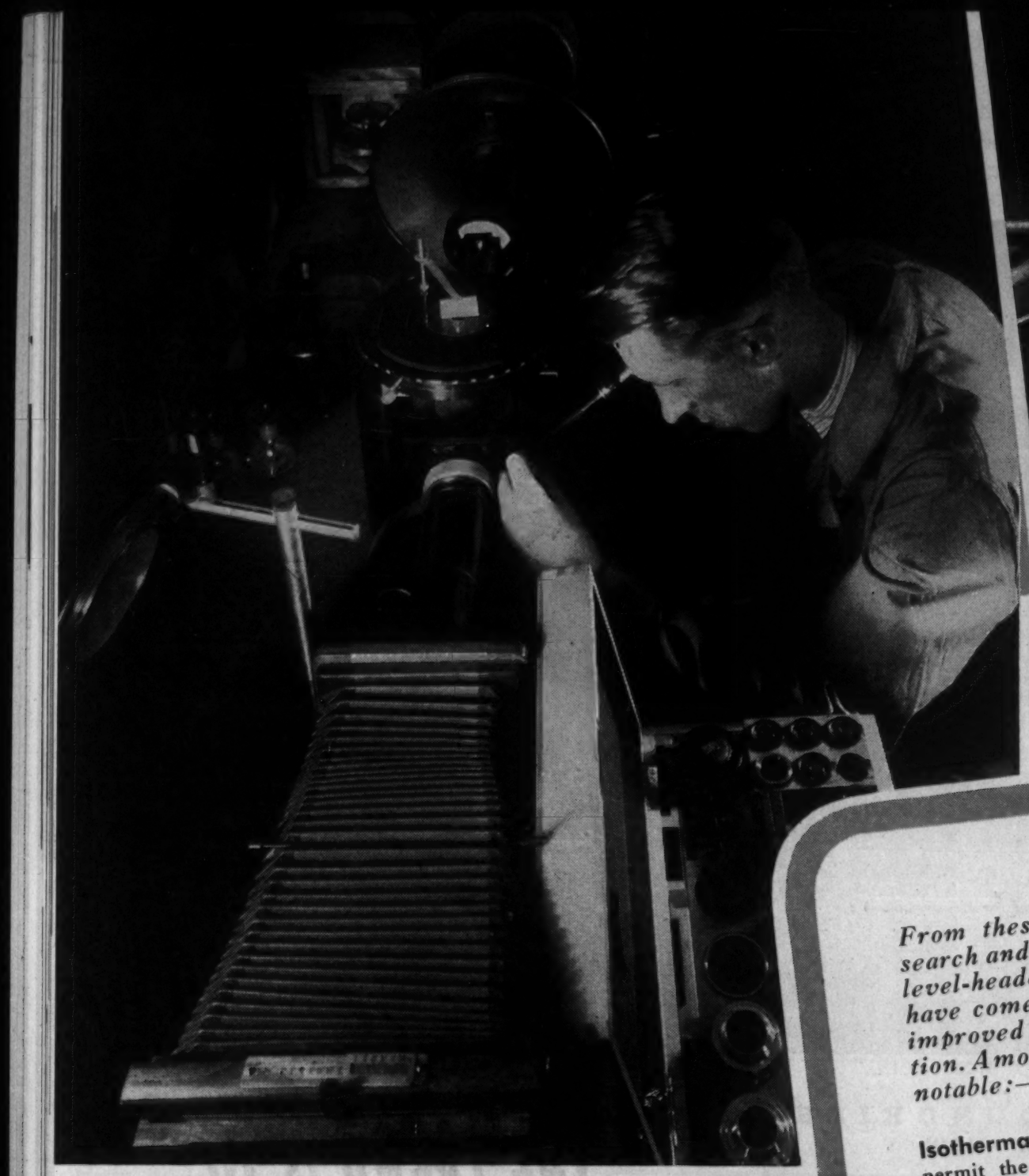
In planning your new product or redesigning an old one—investigate the economies and service available to you.

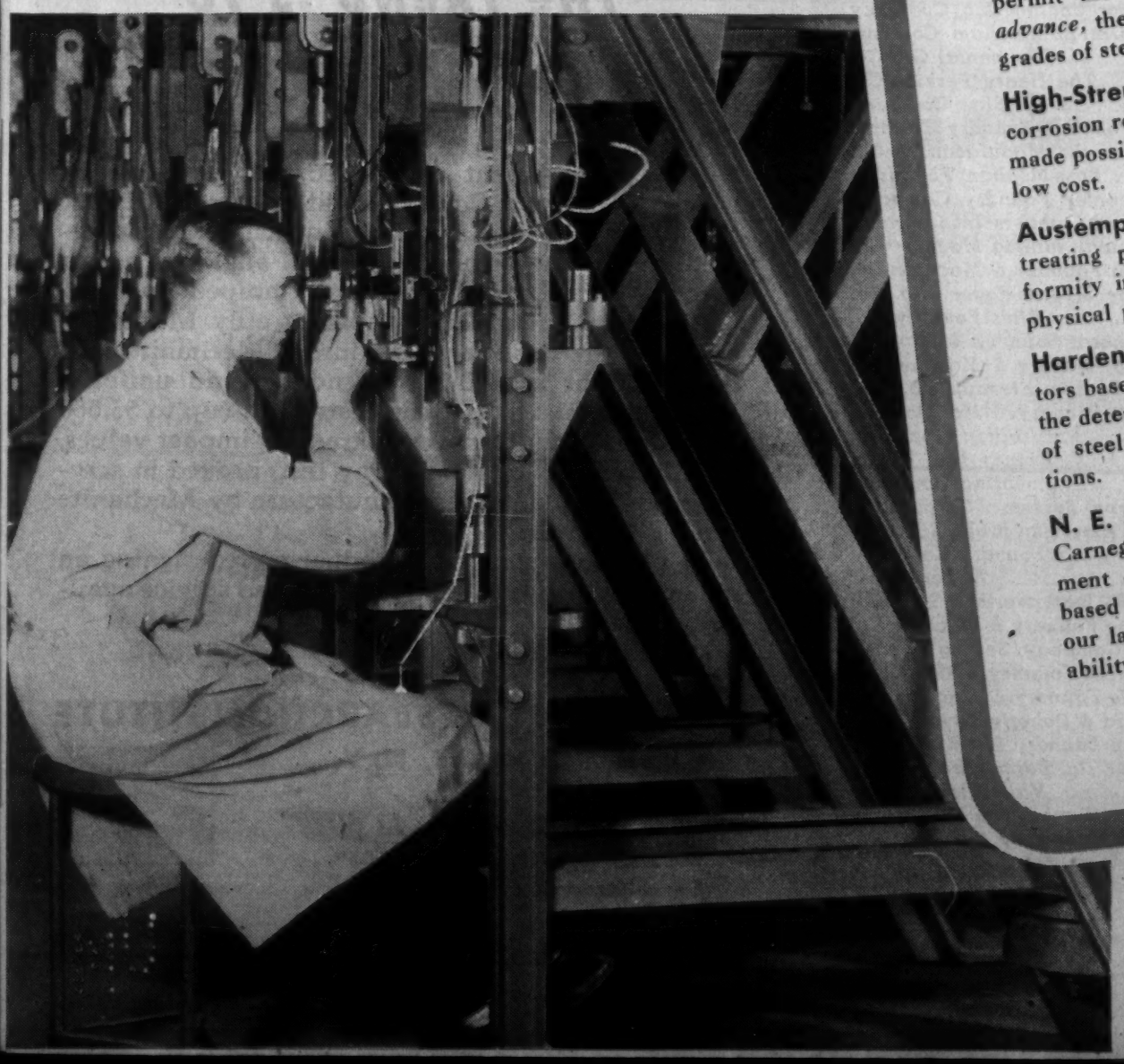
Write Engineering Service Department

MEEHANITE RESEARCH INSTITUTE
NEW ROCHELLE, N. Y.

Ask for Bulletin No. 12
"DESIGN WITH CONFIDENCE"







From these splendidly equipped research and testing laboratories and the level-headed dreamers that staff them, have come new and better steels, and improved methods for their application. Among many, these are especially notable:—

Isothermal Transformation diagrams which permit the steel user to readily determine *in advance*, the heat treatment required for various grades of steels to obtain specific results.

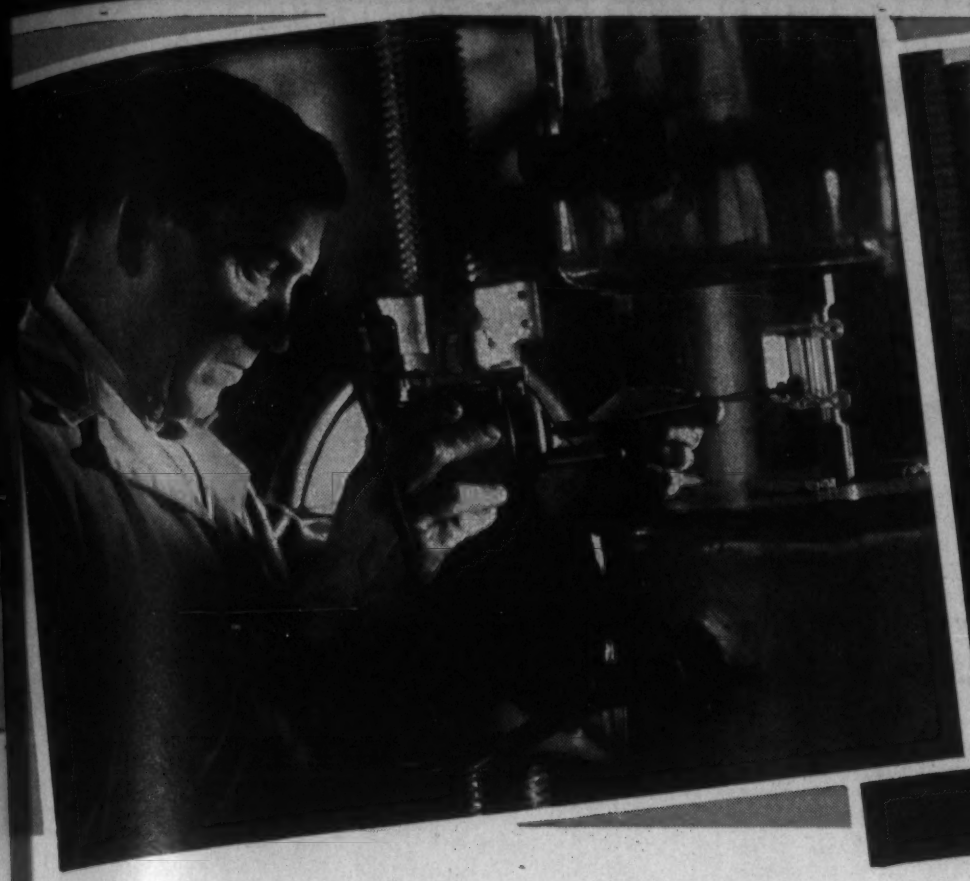
High-Strength steels—combining atmospheric corrosion resistance and high strength which have made possible the safe reduction of deadweight at low cost.

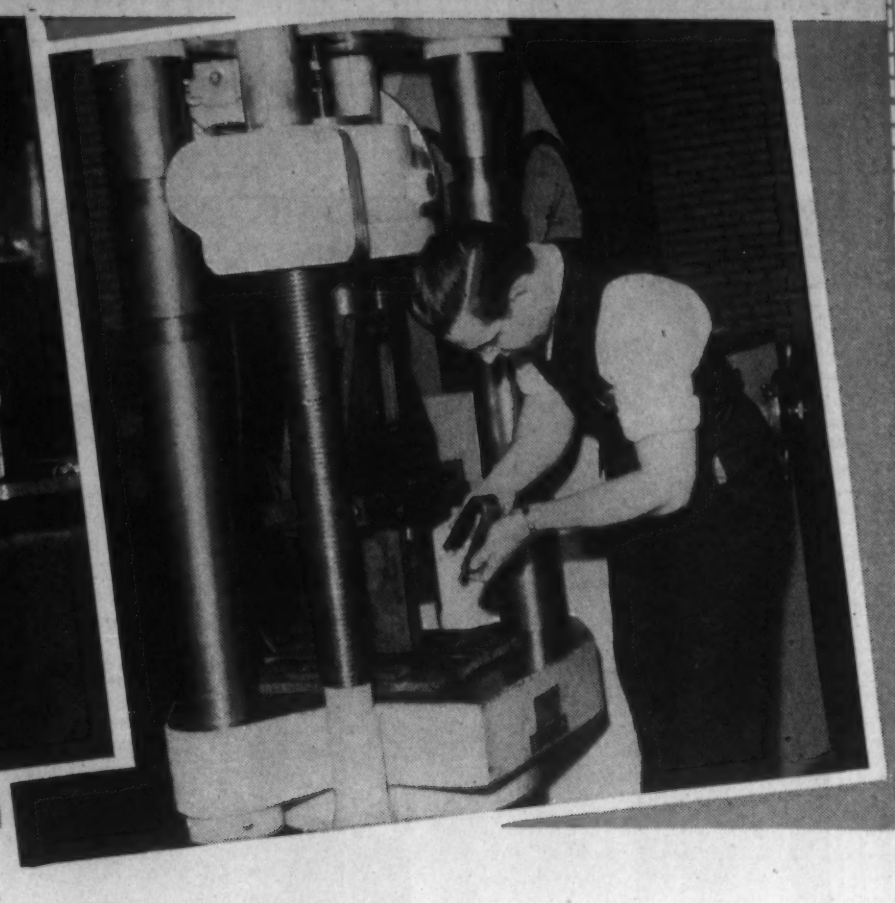
Austempering—and other new and special heat treating processes—which provide greater uniformity in heat treatment and insure improved physical properties in the heat treated condition.

Hardenability studies which by means of factors based on the composition of the steel, permit the determination of the hardening characteristics of steels and their suitability for given applications.

N. E. Steels—Much of the major contribution Carnegie-Illinois was able to make in the development of these National Emergency Steels was based on the valuable research previously done in our laboratories—notably in the field of hardenability.

USS





To cure "steel" headaches before they start

...these men work for you for nothing!

THEIR job is to put steel through its paces. To get rid of bugs that might interfere with your production. To test, and *to find ways to improve* steel's forming, forging and machining qualities—its response to heat treatment — its weldability.

In 174 U. S. Steel laboratories, more than 1200 steel metallurgists, engineers and research workers pre-view steel and make sure—before you use it—that the steel will meet your fabrication requirements as it should, and that it will perform satisfactorily in service.

Right now, when it is vitally necessary that man-power and machinery be used to full capacity, the work of these steel specialists in developing facts that forecast performance is of prime importance in keeping your production lines running smoothly.

It is a plus service that we are proud to be able to offer to every user of Carnegie-Illinois steels. And it is free.

So, too, is the assistance of our metallurgists, and the extensive laboratory facilities at their disposal, in helping you get the most out of the steel now going through your shops. If you want practical help in speeding-up forging and welding operations, in reducing machining schedules, in saving time in heat treating and other fabricating problems, do not hesitate to call on us.

CARNEGIE-ILLINOIS STEEL CORPORATION

Pittsburgh and Chicago

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*
United States Steel Export Company, New York

UNITED STATES STEEL

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to KEEP 'EM OPERATING!

ELECTRICAL ENGINEERS continue their spectacular progress.

Since Pearl Harbor they have designed and perfected equipment that frees military strategy from many of its old limitations.

Through tireless motors big and small, through tiny electronic tubes and gigantic motor generators, through a myriad of instruments and machines these men have put electrical energy to work for Victory.

Constantly striving to improve its products, the electrical industry has acquired long experience with metals and alloys of many kinds.

This experience has demonstrated that when properly used, nothing quite takes the place of Nickel. From resistor grids to armature shafts, from limit switches to reduction gears, Nickel and its alloys have been assuring the dependability so important in equipment that must not fail . . . even under wartime overloads.

Nickel imparts toughness, strength, and fatigue resistance to other metals . . . makes them stand up better under abrasion, wear, shock, and stress.

As in other industrial fields, a little Nickel goes a long way to keep electrical equipment operating.

For years we have enjoyed the privilege of cooperating with technical men of the electrical equipment industry . . . and of many others. Whatever *your* industry may be . . . if you want help in the selection, fabrication, and heat treatment of alloys . . . we offer you counsel and data.

New Catalog Index

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METALS and ALLOYS

Engineering File Facts

NUMBER 43
April, 1944

PROCESSES AND PROCEDURES
Steelmaking

Open-Hearth Furnace Refractories

Refractories for the open-hearth steel furnace serve as heat-resistant materials of construction, and also as chemical materials to resist action by the agents used in purifying the steel. They may be *acid* or *basic*, depending upon the type of impurity to be controlled. While less than 2% of American open-hearth steel production is made in acid furnaces, the refractories used will show no such disproportion, since basic furnaces use a considerable amount of acid refractory above the hearth.

The hearth for the basic furnace may be burned in, using magnesite and slag, or rammed in cold, using magnesite ramming mixtures. The "burned in" hearth requires several weeks for building up, starting with magnesite and up to 15% slag, then decreasing the slag in succeeding layers. The rammed hearth can be shaped cold and put into service within a few days. Burned dolomite is thrown into the furnace, usually by machine, after each heat to repair the banks.

Under the hearth lining are 13½ in. of chrome brick or magnesite brick, with a layer of firebrick and usually insulating brick (4½ in.) on the outside next to the steel shell. A magnesite brick lining may be carried up the side walls above the hearth lining. At the slag line, where the greatest corrosion occurs, a course of chrome brick may be used. Refractories for the rest of the furnace are generally silica brick. The roof is usually 15 to 18 in. thick, and may be made heavier along the back, where wear is greatest. Use of basic brick as wall panels, roof sections, or for the entire roof in small furnaces, has been increasing in Europe and America recently.

The hearth for the acid furnace is built up of silica sand of about 94 to 97% SiO_2, so that purity is high enough to prevent too rapid wearing away, and not so high as to melt at an unduly high temperature. The bottom is "glazed in" in layers of about ¼ in., until a foot or more in thickness. The remainder of the refractory is silica brick, the construction resembling that for the basic open-hearth furnace.

Silica bricks have the advantages of low first cost; relatively light weight (about 105 to 110 lb. per cu. ft.), lowering stresses, great strength and rigidity at high temperatures and good spalling resistance within the proper temperature range. They show a tendency to spall or crack if heated or cooled rapidly while below a dull red heat. Silica bricks have a low melting point (about 3110 F.), and are easily fluxed by basic oxides.

Advantages claimed for basic brick in roof, wall and other construction are: Melting point 500 F. or more higher than silica brick, permitting higher operating temperatures; increased production and longer furnace life because fewer minor repairs are necessary; greater ease of cleaning slag pocket because of granular slag; less sensitivity to overheating, so that the furnace can be driven harder. Hearth temperatures 150 to 200 F. higher were reported when the first basic roofs were used in Europe, with resulting shorter time per heat and lower fuel costs. Basic brick is expensive, may weigh about 50% more than silica brick, has high thermal expansion, and roof construction may cost four or five times as much.

Magnesite bricks may be bonded by firing, or chemically. The former is supplied in an 82 to 85% MgO type, containing 5 to 7% iron oxide, or a 90% MgO with 2 to 3% iron oxide. The chemically bonded bricks are ground dead-burned magnesite with a little chrome ore, and are provided with steel casings for roof service, to increase spalling resistance. Magnesite bricks possess high thermal conductivity, so that a layer of insulating bricks is sometimes used with them.

Chrome bricks, made from a rock containing chromite, are made by firing or chemical bonding, usually with lime or barium oxide. They absorb iron oxide rapidly at temperatures above about 2825 F., tending to swell and crack.

Chrome magnesite bricks are superior to chrome brick in spalling resistance and shear strength. They are usually made with about 25% MgO. While they have been reported used successfully in Europe in open-hearth roofs, they may show a progressive spalling due to absorption of iron oxide.

Forsterite bricks, composed mainly of the mineral forsterite, are very refractory, have a lower thermal conductivity than silica, and are more resistant to spalling than magnesite.

Those silica bricks in which the alumina content exceeds 25% are classified as *fireclay bricks* or *high-alumina bricks*. The former are subdivided into *low, moderate, intermediate, high heat duty* and *super-duty bricks*. The high-alumina bricks are classified according to alumina content as 50, 60, 70, 80 and 90%. Fireclay bricks are used largely where there are rapid fluctuations in temperature in the low temperature range, as in checkerwork, etc.

Service Conditions in the Open-Hearth Furnace
(Based upon an ASTM survey)

Furnace Part	Type of Brick, etc.	Temp. F.	Load	Service Effects
Hearth bottom	Magnesite, chrome	to 3000	not important	Slagging and abrasion
Banks	Dead-burned magnesite and dolomite	"	to 10 p.s.i.	Abrasion — some slagging
Front Wall	Silica brick	"	to 10 p.s.i.	Slagging and spalling
	Magnesite, metal cased			
	Chrome brick	down to 1200		
Back wall	Silica brick	to 3000	to 10 p.s.i.	Slagging and sometimes abrasion
	Magnesite brick			
	Chrome brick	down to 1200		
Roof	Silica brick	1200 to 3000	Arch stresses	Spalling and slagging
Ports	Silica brick	"	not important	Abrasion and slagging
Bulkhead (end wall)	Silica brick	to 2900	10-15 p.s.i	Slagging and abrasion
	Magnesite brick			
	Chrome brick	down to 2000		
Downtake	Silica brick	2000 to 2900	15-20 p.s.i.	Slagging — some abrasion
Slag pocket	Silica brick	"	5-10 p.s.i.	Slagging action
Upper checkers	High heat duty fire-brick	Air — 250 to 2600	5-10 p.s.i.	Slagging and abrasion at top
	Silica brick	Gas — 1100 to 2400		
Lower checkers	High heat duty fire-brick	"	10-20 p.s.i.	Slagging and abrasion at top
Flue to stack	Intermediate heat duty fire-brick	to 1350	not important	not important
Stack	Intermediate and low heat duty fire-brick	to 1200	not important	not important

Prepared by Kenneth Rose, Engineering Editor

SILVER RELIEVES THE TIN BABBITT SHORTAGE

Uncle Sam's Silver pays out in full. Lead-base, alloyed with silver, provides the same hot strength as tin-base babbitts, with the same general physical characteristics:

Retains hardness at high temperatures • Easy to handle and to bond • Resists squeezing-out at operating temperatures • Corrosion resistant.

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PLANTS IN: ST. LOUIS, MO. • PITTSBURGH, PA. • MEADVILLE, PA. • JERSEY CITY, N. J. • PORTSMOUTH, VA. • ST. PAUL, MINN. • CHICAGO, ILL.

Copper Alloy Castings—1

This is the first section of a two-installment table. The second installment will present similar data for cast nickel brasses and bronzes, high-tin bronzes and aluminum bronzes.

TYPE		COMPOSITION, PER CENT																	USES
		Cu	Zn	Sn	Pb	Fe	Si	Mg	P	Sb	Cr	Ni	Co	Be	S	Impurities	Al	Mn	
High conductivity copper alloy		99.85 M	0.020 M	0.020 M	0.020 M	0.050 M	0.020 M	0.020 M	0.005 M	0.005 M									Electrical conductivity applications
High-copper precipitation hardening conductivity alloys	1	99.72					0.08				0.80								
	2	96.40					0.60					3.00							
	3	97.00					0.60						2.40						High thermal and electrical conductivity
	4	97.00											2.60	0.40					
	5	99.50									0.40			0.10					
Valve bronzes and red brasses	1	86.50 M	2.00-5.00	5.50-6.50	1.50-2.00	0.25 M	0.005 M		0.05 M			1.00 M			0.05 M				Pressure castings
	2	84.00-86.00	4.00-6.00	4.00-6.00	4.00-6.00	0.25 M	0.005 M		0.05 M	0.25 M		1.00 M			0.05 M				Pressure work at temps. not above 400°F.
	3	76.00-78.00	5.50 6.50	4.00-6.00	9.00-11.00	0.25 M	0.005 M		0.05 M	0.15 M		1.50—2.50			0.05 M				Refrigeration metal
Semi-red brasses	1	83.00	5.00 7.00	3.25-4.75	5.00-7.00	0.25 M	0.005 M		0.05 M	0.25 M		1.00 M			0.05 M				
	2	80.00	7.50-9.50	2.50-3.50	6.25-7.75	0.25 M	0.005 M		0.05 M	0.25 M		1.00 M			0.05 M				Radiator valves, low pressure steam fittings, low-pressure water fittings, alloys 3 and 4 widely used for plumbing fixtures.
	3	77.00	9.00-10.00	2.50 3.50-	9.00-11.00	0.25 M	0.005 M		0.05 M	0.25 M		1.00 M			0.05 M				
	4	78.00	12.00-14.00	1.50-2.50	6.00-8.00	0.25 M	0.01 M		0.03 M	0.25 M		1.00 M			0.05 M				
Yellow brasses	1	70.00-71.00	20.00-24.50	1.00-2.00	2.00-4.00	0.30 M	0.10 M		0.01 M	0.10 M		0.50 M			0.05 M	0.50 M			Used widely in plumbing industry
	2	60.00-62.00	30.00-35.00	1.00M	1.00-3.00	0.30 M	0.10 M		0.01 M	0.10 M		0.50 M			0.05 M	1.00 M	0.50 M		
Manganese bronze	1	55-62	Rem.	0-1.5	0.4M	0.6—2.0											0.5—1.5	0.2—3.5	Propeller hubs & blades, gas engine bases, valves, valve stems, pump bodies, hydrostatic elements, lever arms, etc., in marine service.
	2	56-65	Rem.	0-1.00	0—0.2	2—5						0—3.00					2—7	2—6	
Copper-silicon alloys	1	94.9					4.0											1.1	Used extensively in sewage disposal equipment, marine hardware, chemical process equipment, pipe fittings, valves and pumps for handling corrosive liquids, electrical conduit fittings and transmission line conductors.
	2	94.4				1.5	4.0		0.05									0.05	
	3	94.75	1.0				4.25												
	4	97.12					2.88												

(Continued on page 889)

Why

B&W Tubing Recommendations

are Reliable, Impartial

If you have a job for tubing to do . . . if you're in doubt whether Seamless or Welded Tubing . . . which physical properties . . . are best suited for your requirements, Babcock & Wilcox can help you with sound advice. There are important reasons why this help is unusually valuable.

For instance, B&W makes BOTH Seamless and Welded Tubing in specialty tube mills where each inquiry or order receives individual attention. This is a big advantage to users because they can be sure of always getting *impartial* tube recommendations.

Then, too, behind every B&W tube is over 20 years' engineering and manufacturing experience and a long list of "firsts" in tubing research and development.

You can simplify your tubing problems by coming to B&W, and you also can centralize your tube engineering and purchasing.

TA-1285

B&W TUBES

SEAMLESS
Complete range of carbon and alloy steels
Sizes: ½ in. to 8⅝ in. O.D.

ELECTRIC-RESISTANCE WELDED
Carbon grades
Sizes: ¼ in. to 4 in. O.D.

THE BABCOCK & WILCOX TUBE COMPANY

SEAMLESS TUBE DIVISION
BEAVER FALLS, PA.

WELDED TUBE DIVISION
ALLIANCE, OHIO

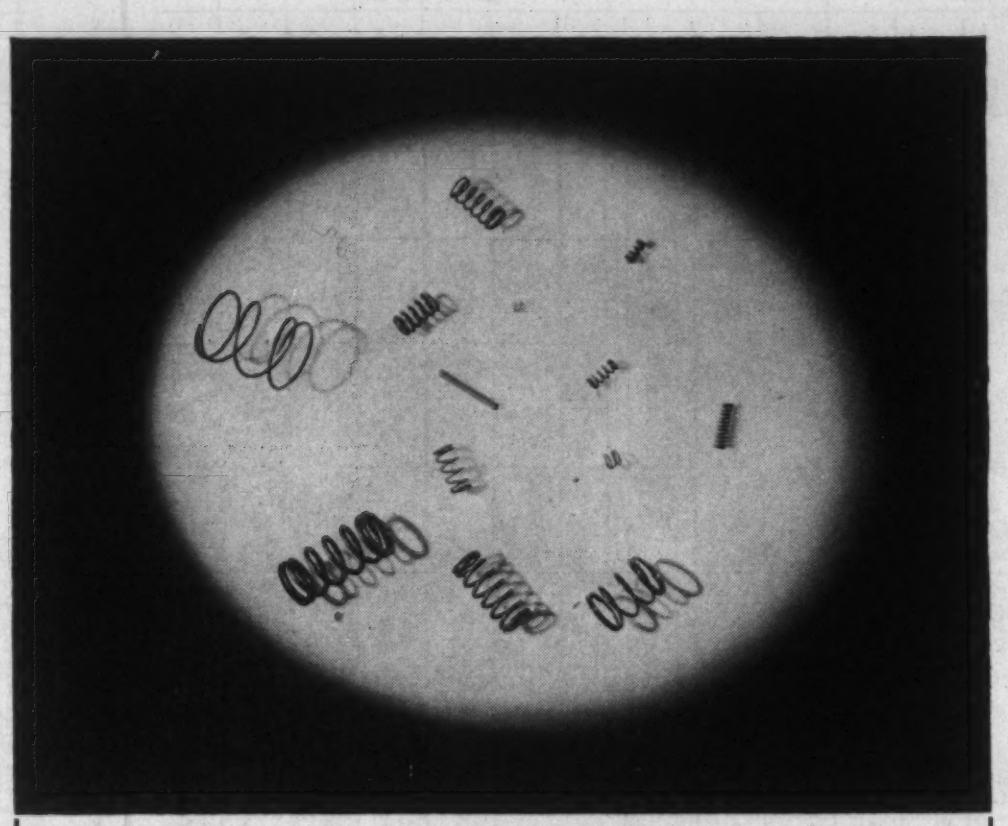
TYPE		PROPERTIES															
		Propor. limit p. s. i.	*Ten. str., p. s. i.*	*Yield point, p. s. i.*	*Elong., % in 2 in.*	*Brin. hardness*	*Specific gravity*	*Elec. cond., %*	*Thermal conductivity*	*Reduction of area, %*	*Mod. of elasticity, p.s.i.*	*Weight per cu. M-lb.*	*Resis. to impact, ft.-lb.*	*Coeff. thermal exp.*	*Specific heat*	*Compressive stress**
High conductivity copper alloy			25,000-30,000	16,000-19,000	40-50	35-42	8.8	80	0.900[5]							
High-copper precipitation hardening cond. alloys	1		52,000	35,000	18	100		85								
	2		75,000	65,000	15	140		45								
	3		65,000	50,000	15	120		65								
	4	45,000	90,000		10	220		45								
	5	15,000	30,000		15			75								
Valve bronzes and red brasses	1	8,000	34,000-42,000	16,000-22,000	22-30	60-70[1]	8.6			23-27	12,000,-000	0.314	16[10]			
	2	8,000	30,000-38,000	14,000-20,000	20-30	55-65[1]		16.4[4]		25-29	11,000,-000	0.314	9[10]	18.4[7]		
	3		25,000-30,000-	12,000-18,000	15-25	50-60[1]	8.7					0.320				
Semi-red brasses	1		30,000-36,000	15,000-20,000	20-30	55-65[1]	8.6			20-30		0.314				
	2		30,000-36,000	15,000-20,000	15-25	55-65[1]	8.6			15-25		0.314				
	3		25,000-30,000	12,000-17,000	10-20	50-60[1]	8.7					0.320				
	4		30,000-36,000	15,000-20,000	15-25	55-65[1]	8.6					0.315				
Yellow brasses	1		30,000-35,000	15,000-20,000	25-35	50-60[2]	8.5			25-35		0.310				
	2		35,000-45,000	18,000-25,000	15-25	55-65[2]	8.5	26.[4]	0.286[6]	20-30	15,000,-000	0.300		0.000-0204[5]	0.09-09[14]	
Manganese bronze	1		65,000-75,000	35,000-50,000	20-30	100-120		25-35		20-30		0.302	20-40[10]			12,000-16,000-
	2		90,000-110,000	50,000-70,000	10-20	180-240		11-14		10-20		0.302	7-15[11]			60,000-70,000
Copper-silicon alloys	1		48,000-58,000	18,000-25,000[20]	20-50	80-100[1]	8.23	5.6[4]	7.2[21]					0.000-018[8]		
	2		48,000-58,000	18,000-25,000[20]	20-50	80-100[1]	8.44	5.6[4]	7.2[21]					0.000-018[8]		
	3		48,000-58,000	18,000-25,000[20]	20-50	80-100[1]	8.37	5.6[4]	7.2[21]					0.000-018[8]		
	4		40,000-50,000		30-40			6.5[4]	9.0[21]							

* *Compressive stress for 0.001-in. (deformation of a 1-in. cube per sq. in.)*

Compiled by N. F. Hindle, Asst. Secretary, American Foundrymen's Association

This table also appears in the book "Handbook on Designing for Quantity Production", by Herbert Chase.

SPRING GRADE WIRE is Now the First Step in Micro-Processing



Meets higher specifications than established ASTM Standards

"Silvercote" Spring-Grade Wire used in Micro-processed Springs has these guaranteed properties: Guaranteed minimum tensile strength, 190,000 lbs. per sq. in. after hardening. High uniformity in temper. Accurately controlled conductivity.

Better Coil Springs at No Added Cost

Micro-processing essentially is a specialized production technique by which the inherent electrical and mechanical properties of beryllium copper are controlled to produce maximum performance in coil springs.

Years of laboratory research and design experience by Instrument Specialties Company has indicated that the ultimate in spring performance could not be reached until a beryllium copper wire of guaranteed "spring grade" were available. Now, an adequate supply of this premium quality beryllium copper wire is an accomplished fact as the data to the left signifies. Silvercote Spring-Grade beryllium copper wire is being used 100% by Instrument Specialties for coil springs of all types. As a result, Micro-processing can do even a better job than ever before — at no added cost to you.

By using this special wire with guaranteed premium spring qualities, it naturally follows that peak spring performance is achieved in the micro-processing.

Every Micro-Processed Coil Spring Benefits

Plain or "fancy" springs benefit by the addition of Spring-Grade Beryllium Copper wire to the other values of Micro-processing — higher safe working stresses, less loss of tension, higher proportional limit, maximum conductivity, higher safe operating temperature, lower electrical loss, freedom from set or drift, and closer tolerances.

It would pay you to evaluate Micro-processed beryllium copper springs for your own use. Instrument Specialties Company produces coil springs which out-perform in service because every step in their production is controlled — beginning with Spring-Grade wire.

I-S Brush Spring Data Sheet

The quicker easier way to put Micro-processing to work — fill out the I-S Data Sheet and we'll do the rest. Write for data sheets today, or send your specifications and inquiries. Remember Micro-processed brush springs are easier to assemble, add life to brushes and give maximum performance in service.

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METALS and ALLOYS

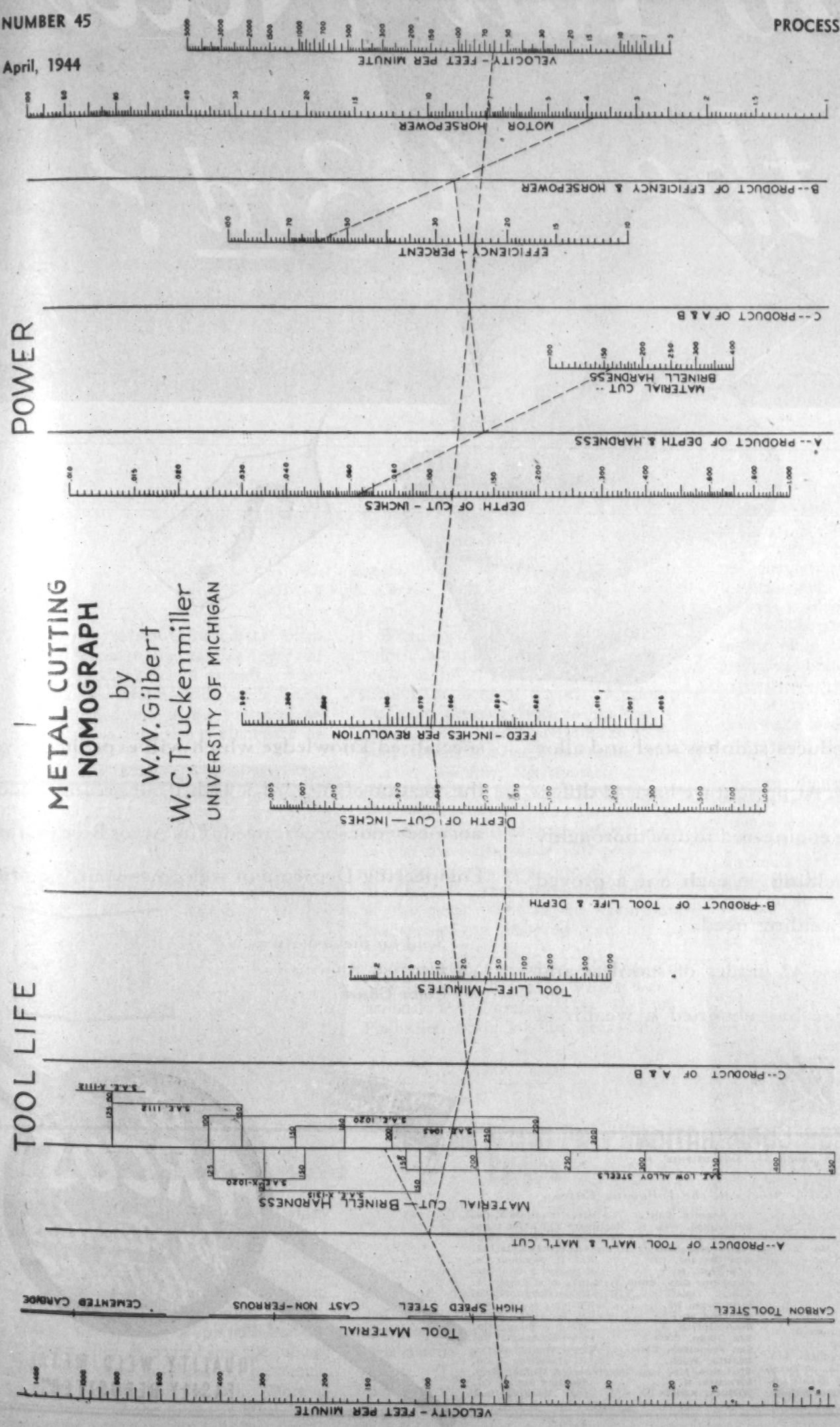
Engineering File Facts

NUMBER 45

April, 1944

METAL CUTTING NOMOGRAPH I

by
W. W. Gilbert
W. C. Truckenmiller
UNIVERSITY OF MICHIGAN



TOOL LIFE

SAMPLE CALCULATIONS
POWER

GIVEN:
FEED ---------- 0.0028 INCHES PER REV.
VELOCITY ---------- 60.5 FEET PER MINUTE
DEPTH OF CUT ---------- 0.0625 INCHES
MATERIAL CUT ---------- 160 B.H.N. - SAE 1020 STEEL
MACHINE EFFICIENCY ---- 80 PERCENT

READ FROM CHART:
MOTOR HORSEPOWER = 3.75

MAXIMUM OUTPUT

GIVEN:
TOOL MATERIAL
MATERIAL CUT
TOOL LIFE
DEPTH OF CUT
(DEEPEST CUTS MOST EFFICIENT)
MACHINE EFFICIENCY
MOTOR HORSEPOWER
(USE RATED HORSEPOWER)

THE FEED SHOULD BE VARIED UNTIL THE VELOCITY ON THE
THE TOOL LIFE SIDE IS EQUAL TO THE VELOCITY ON THE
POWER SIDE. THIS FEED AND SPEED WILL GIVE THE
MAXIMUM METAL REMOVAL FOR THE GIVEN CONDITIONS.

SAMPLE CALCULATIONS
TOOL LIFE

GIVEN:
TOOL MATERIAL ---------- HIGH SPEED STEEL
MATERIAL CUT ---------- 160 B.H.N. - SAE 1020 STEEL
DESIRED TOOL LIFE ------ 60 MINUTES
DEPTH OF CUT ---------- 0.0625 INCHES
FEED ---------- 0.0625 INCHES PER REV.

READ FROM CHART:
VELOCITY = 60.5 FEET PER MINUTE

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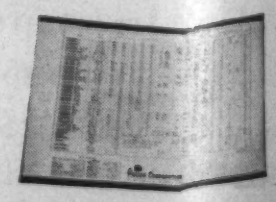
Arcos produces stainless steel and alloy electrodes exclusively. At present we have 42 different grades ... each one engineered to do a thoroughly dependable job of welding . . . each one a proved answer to a specific welding need.

In developing these 42 grades of stainless and alloy electrodes, Arcos has obtained a wealth of specialized knowledge which will expedite for you the creation of the 43rd or 44th, if our present list does not meet your specific need. The Arcos Research and Engineering Department welcomes your inquiries.

Send for the new Arcos Electrode Analysis and Color Chart.



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Buffalo, N. Y. ..... Root, Neal & Co.	Moline, Ill. ..... Machinery & Welder Corp.
Chicago, Ill. ..... Machinery & Welder Corp.	Montreal, Canada . G.D. Peters & Co. of Canada, Ltd.
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	Wichita, Kansas ..... Watkins, Inc.

"QUALITY WELD METAL EASILY DEPOSITED"

METALLURGICAL ENGINEERING shop notes

Low Melting Alloy Braces Tubing

by M. C. Seguin,
Curtiss-Wright Corp.

Tubing or hollow extrusions are often used to support the trailing edge of ailerons, rudders, etc. of aircraft. They collapse and deform easily while being riveted, drilled, etc. in the course of attaching. This trouble was eliminated by

using a eutectic alloy, Cerro-Bend, which melts at 160° F.

The tubing is stood on end, resting in a pan containing ½ in. of cold water. A few drops of oil are poured in to facilitate removal of the alloy. Then, melted Cerro-Bend, a bismuth-lead-tin-cadmium alloy, is poured into the tubing. The cold water solidifies it, preventing it from running out the end. More is poured in until the tubing is filled.

When cooled, it retains its dimensions without shrinking. Now the tubing is ready to be riveted or drilled, always keeping its original shape. Moreover, the alloy permits rivets to conform to contour because more pressure can be applied without damage to the trailing edge.

After assembly, the complete part is submerged in a hot water tank, kept at 180 to 200° F. by steam pipes. The assembly is inverted on a slight angle so that the melted alloy will pour from the tube into a small pan at one end of the tank, thus permitting recovery of the metal. Use of the Cerro-Bend has speeded up the production rate by 1000%.

[The author, connected with the Columbus branch of Curtiss-Wright, won a national award certificate by the War Production Board for this idea.—Editor]

Deburring Aircraft Parts With Pebbles

by Millard C. Faught,
Nash-Kelvinator Corp.

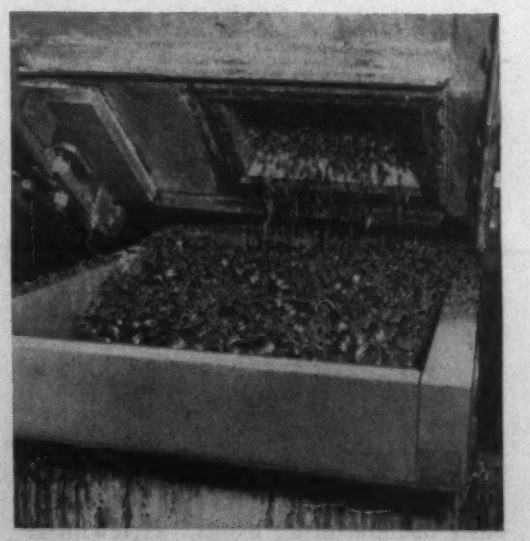
An increasing use is being made of roto tumbling methods for deburring small parts made of steel, bronze and aluminum, for aircraft engines, propellers and other war material at the Nash-Kelvinator Corp. plants. The tumbling operations do superior work in approximately 5% of the time required by manual methods.

Rocker arms, steel gears, spark plug bushings, washers, etc. are put into rotating barrels, together with agate or granite stones and small quantities of an abrasive compound in a water solution. Often sal soda is added to prevent rust.

It will be noted that pebbles are used in the place of steel balls because they are more abrasive in themselves, are less expensive, do not involve priorities and do not rust. Steel balls are effective principally in dry deburring operations.

A typical run may consist of 400 lb. of stone, 150 lb. of work and 10 lb. of roto compound. With water, the tumbler is 2/3 full. The process takes from a half-hour to 3 hr. at 30 r.p.m.

It is effective on delicate parts. Thus, a certain part for a Pratt & Whitney engine contains 64 different facets. These were originally filed manually, five pieces per hr., with considerable rejects because of deep file marks.



A tumbling barrel can do 175 per hr., with practically no waste. Profilometer tests show finished parts to have a uniform sand finish, a good base for paint.

Foundry Chaplets of Monel

by F. G. Sefing,
International Nickel Co.

In foundry practice cores are held into position with nail- or peg-like pieces of metal called chaplets. They not only hold up the cores but overcome the buoyancy of the molten metal. For soft gray iron castings, poured at low temperatures, plain steel chaplets are satisfactory. But for high-strength cast iron or corrosion resistant alloy irons, neither steel nor tinned steel are satisfactory.

Where the steel is tinned the protective coating is added for corrosion protection, since even if the chaplet itself fuses with the casting it may leave an exposed area at the surface of the core. Again, where rusted chaplets are used, gas formations will ensue when the molten metal contacts the rust, threatening the soundness of the casting.

Many foundries now use Monel chaplets, especially for the higher pouring temperatures of high-strength gray iron and other alloys, ferrous and non-ferrous. The melting point of Monel is from 2370 to 2460° F., which affords good surface fusion with irons and alloys that are poured from 2550 to 2850° F. Monel chaplets maintain much higher strengths than steel near the fusion point or until the casting begins to set.

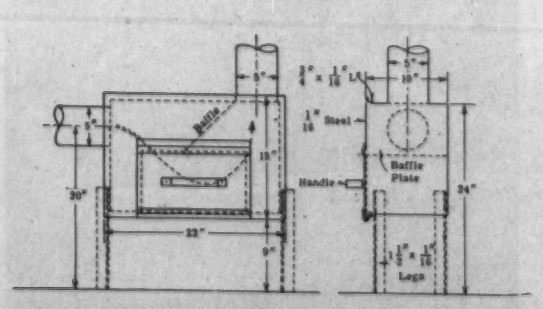
Monel is, of course, highly resistant to corrosion. The chaplets have equal or better corrosion resistance than the castings themselves and prevent corroding out in acids. They also prevent the necessity of drilling out steel chaplets and inserting plugs of the same metal as the casting.

For unusual forms and dimensions suitable thicknesses of Monel sheet can be formed in the foundry to secure required shapes.

Collector for Recovering Metallic Particles

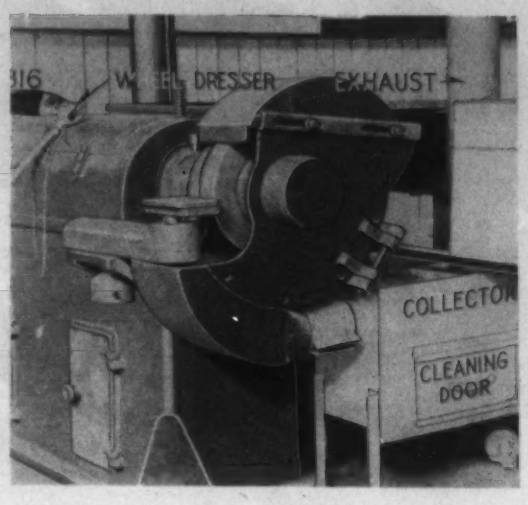
by F. R. Elliot,
Westinghouse Electric & Mfg. Co.

In this era of scarce metals, it is desirable to collect every speck of metallic dust in grinding operations, particularly from the more valuable alloy metals, whether in foundries, machine shops or



other manufacturing plants. Herewith is pictured by diagram and photograph a simply-made collector of dust from a snag grinder.

A suitable exhaust connects the collector to the outside atmosphere, and a baffle within the collector deflects the metallic particles so that they will not be carried on through the exhaust and wasted in the atmosphere. The collector is emptied through a door in its side.



In the photograph attention is drawn to the wheel dresser, which is kept permanently at the grinder for instant use. In the sketches, the one at the left shows the collector with respect to the snag grinder, and shows the exhaust from the collector. The construction of the baffle is emphasized in the drawing at the right.

Since the oxides of no two metals are the same, it is wasteful to try to use any but the right flux for a particular metal. The wrong flux may result in an unsound weld. To avoid waste, don't dip the welding rod into a full can of flux, but rather into a smaller receptacle, preferably cone-shaped, containing just enough flux to complete the job. Be sure that it all goes into the molten puddle and is not shaken off outside the welded area. If the aluminum flux that you use was originally packed in a glass jar by the manufacturer, don't put it in a metal container for it may react with metals.

—"Oxy-Acetylene Tips",
Linde Air Products Co.

Temperature Control of Wire Drawing

by E. P. Hall,
Kennecott Wire & Cable Co.

A wire drawing compound has several purposes, one of which is to lubricate, another insulate, impart good qualities to the wire, etc. A refinement in the use of such compound is keeping it at a constant temperature — 130 F. in our plant — the means being a Niagara Blower Co. heat exchanger.

In summer, the compound is fed to the exchanger at about 160 F.; in winter, around 115 F., but it invariably emerges from the heat exchanger, hence back to the wire drawing machines at quite precisely 130 F. These compounds are water soluble soaps, fats and oils.

The solution as supplied to the machines contains 1 to 5% of fat (or equivalent) as determined by a Babcock test. The soaps and lower concentrations are used for the finer wire.

Two major difficulties occur in warm weather if the drawing compound has not been adequately cooled. The wire as drawn, comes from the machines so hot that when wound on reels, it will oxidize enough to spoil the appearance. Secondly, when the wire is needed in hard-drawn conditions, the stored-up heat in the reels, after drawing, is sufficient to cause incipient annealing, which, though small, is enough in many cases to prevent the wire from passing A.S.T.M. specifications for hard-drawn wire.

The cooling water in the heat exchanger is recirculated to a considerable extent, yet when necessary, some of the water is automatically changed. The compound is used indefinitely, water and lubricant being added as needed. The sludge is allowed to settle and is removed periodically.

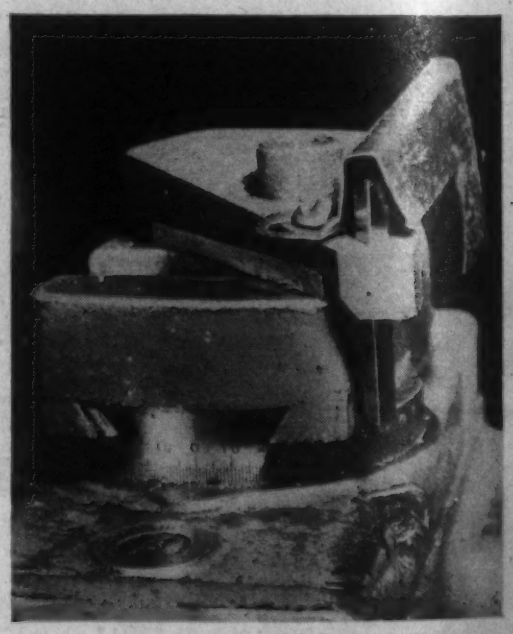
Tool Mounting and Hood for Precious Metals

by Joseph Geenens,
General Electric Co.

A special vertical tool mounting and hood for use when turning platinum and silver alloys in a bench lathe permits a fine finish, minimizes cuts, and serves as a chip collector for the precious metals.

The tool is mounted vertically in the front corner of a triangular steel block, the under surface of which is cut at an angle to provide adjustment when mounted on the cross-slide of the lathe.

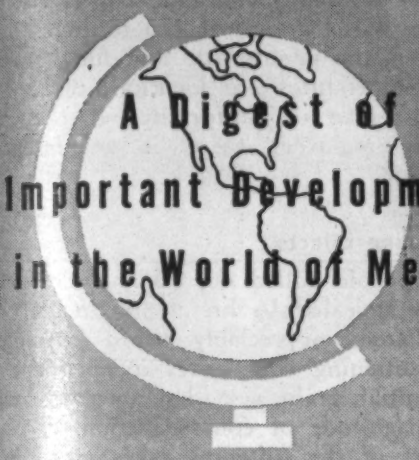
The tool is ground without a chip curler, but the hood collects the chips and carries them back along the block away from the work. This prevents the chips,



which are long, tough and stringy, from becoming entangled in the work.

The turning time is halved by this arrangement, which was devised by the author, assistant general foreman at a G. E. plant.

Metallurgical Engineering Digest



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1 Metal Production

Blast Furnace Practice, Smelting, Direct Reduction and Electrorefining • Open-Hearth, Bessemer, Electric Furnace Melting Practice, Equipment and Refractories • Melting and Manufacture of Non Ferrous Metals and Alloys • Soaking Pits and other Steel-Mill and Non-Ferrous-Mill Heating Furnaces • Steel and Non-Ferrous Rolling, Wire Mill, Pickling and Heavy Forging Practice

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Brass Rolling and Annealing

Condensed from a Paper of the Institute of Metals

Three series of 70-30 brass strip were prepared with different initial grain sizes: Series A, 0.01-0.015 mm.; series B, 0.025 mm.; series C, 0.06-0.065 mm. The thickness of the hot rolled strip was such that it could be reduced to 0.025 in. by 10 to 95% cold rolling.

The mechanism of deformation taking place during cold rolling was followed by X-ray and microscopical examination; this deformation progresses by two mechanisms similar to those for HC copper. The number of strain lines increased with increasing cold reduction until these lines were present in almost every crystal at 40 to 50% cold work; they had no particular orientation to the rolling direction.

With more cold reduction, a second set of strain markings, heavier and further apart, was found; these were approximately transverse to the direction of rolling and inclined at about 35° to the strip surface. There is evidence that the crystals disintegrate into minute fragments with over 80% cold rolling.

The work hardening curves show that the initial differences in hardness of the three series decrease with increasing cold reduction. Curves of hardness versus the degree of deformation have two linear portions: (1) A steep part up to 50% cold reduction (deformation by slip); and (2) a less steep part over 50% reduction (deformation by breaking up crystals).

Independent of initial grain size, the grain size of the strip finally annealed at 750 F. decreases with increasing rolling reduction. At higher annealing temperatures, the effect is not very marked. The increased final annealing temperature usually increases the grain size, but no abnormal crystal growth takes place, such as has been shown to occur in copper.

The degree of uniformity of the grain size in the finally annealed strip is affected by the initial grain size and rolling. Likewise, if the penultimate and final annealing temperatures are identical, there is a high degree of uniformity; if they are widely removed, there is an irregular structure.

Annealing Effects

Strip cold rolled 40, 70 and 95% was finally annealed ½ hr. at 390 to 1470 F. All harden appreciably before softening. The softening commences independent of the initial grain size, but increases with the magnitude of cold reduction.

Half of the softening takes place in a limited temperature range; the other half (associated with crystal growth) extends over a wide temperature range. The initial grain size has no effect on the hardness of the annealed material that has been cold rolled 95%.

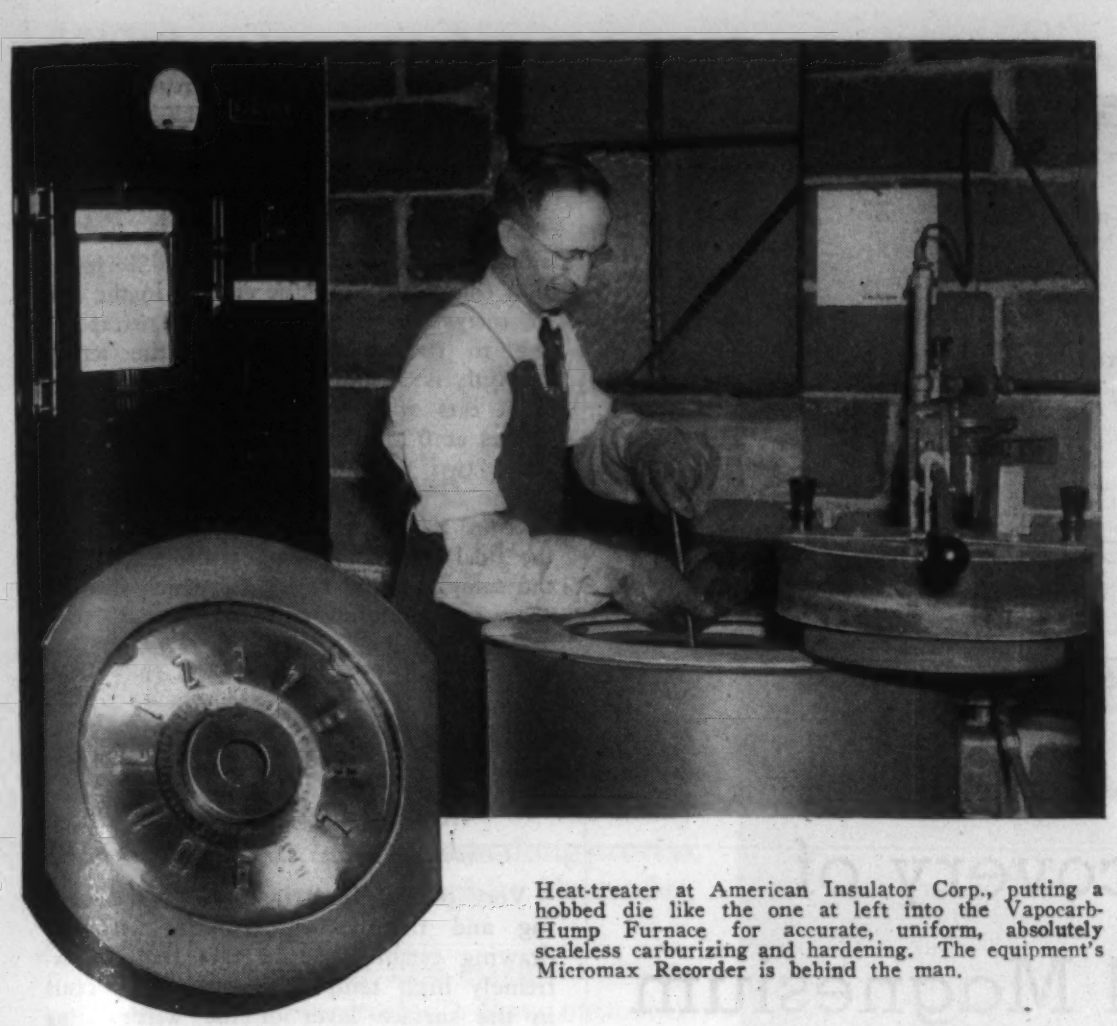
With the smaller amounts of cold rolling, the initial grain size has no effect on the hardness after annealing at 1290 and 1470 F., but with lower annealing temperatures (570 to 930 F.) the annealed hardness increases with decreasing initial grain size.

Tensile tests were made on samples cut at various angles to the direction of rolling. On strip finally annealed at 1070 F., the initial grain size has no apparent effect on the tensile strength, but the amount of cold rolling does:

% Cold Rolling	Angle Relative to Direction of Rolling	
	Minimum Tensile Strength	Maximum Tensile Strength
75	45°	0 and 90°
95	55°	10-20° and 90°

The maximum of elongation coincides with the minimum tensile strength, and the minimum elongation with the maximum tensile strength. Cupping tests were made on strip finally annealed at 930, 1070 and 1290 F. With up to 60 to 80% cold rolling, most of the samples formed 4 ears at 45° to the rolling direction; however, series C formed flat topped cups with up to 60% cold rolling, although it behaved similarly to series A and B for 60 to 80% cold rolling.

The height of the ears of series A and B



Heat-treater at American Insulator Corp., putting a hobbed die like the one at left into the Vapocarb-Hump Furnace for accurate, uniform, absolutely scaleless carburizing and hardening. The equipment's Micromax Recorder is behind the man.

WAR-BUSY TOOLROOMS

Use The Vapocarb-Hump Method For Successful Hardening

How well the Vapocarb-Hump Method of hardening meets the varied needs of today's busy toolrooms is illustrated by the experience of the American Insulator Corp., New Freedom, Pa.

This firm's normal production is a wide variety of plastic articles. These are manufactured by die-molding, and the heat-treatment of the molding dies introduces two problems — carburizing the dies, and hardening the hobs or punches with which dies are formed.

In carburizing, the dies must be kept absolutely "clean" and unpitted, or many man-hours will be spent in "polishing out" the flaws. In hardening the punches, results must be correct, or the expensively-engraved tool may distort or break, when a hydraulic press forms a die by forcing the hob into a block of iron; and a tool engraver will then spend weeks making another punch.

Both carburizing and hardening difficulties have been overcome with the help of the Vapocarb-Hump equipment shown above. In carburizing, the dies are put, absolutely bare, into the Furnace. At about 1200 F the heat-treater admits Vapocarb gas; this replaces all air in the furnace, blankets the dies in a carbon-rich vapor from which all impurities have been eliminated. When the dies reach carburizing temperature, the Furnace's Micromax Controller automatically holds them constant, while they absorb as much carbon as the heat-treater wishes. Then, after he skillfully quenches them, they are as "clean" as when they entered the Furnace.

Jrl Ad T-621(30)

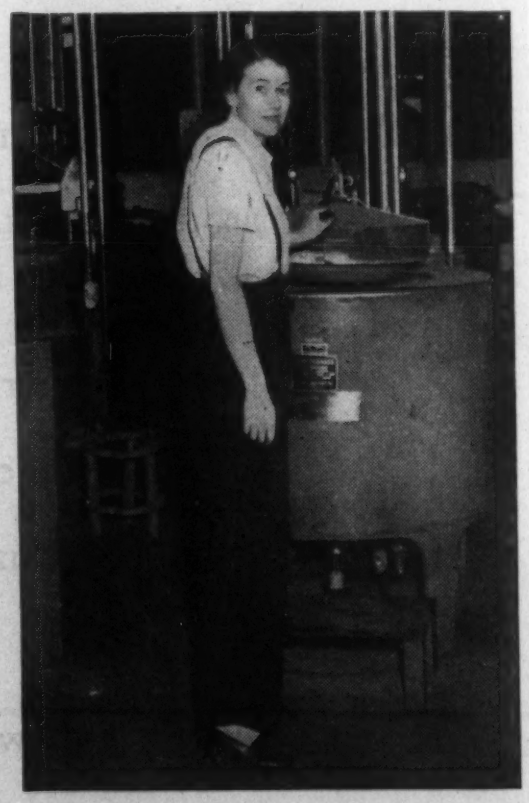
V depends on me!

A Slogan For Every American

In hardening hobs, where deep-seated strength as well as perfect surface must be attained, the heat-treater uses the Hump Method to its full extent. He first employs the Micromax Record to find how fast the hob "likes" to heat; then he sets the instrument's control dial so that this rate will not be exceeded as the steel reaches its critical stage.

Having thus assured correct heating, the heat-treater watches for the "hump" by which the hob indicates, on the Micromax chart, that it is in the critical range. Knowing how far past the critical the tool should heat, the heat-treater quenches at that point; freezes the structure there, assuring long life for the tool.

Vapocarb-Hump Hardening is further described in Catalog T-621. If you have a war-work problem in tool hardening, an outline of the problem to us will get fast, direct action.



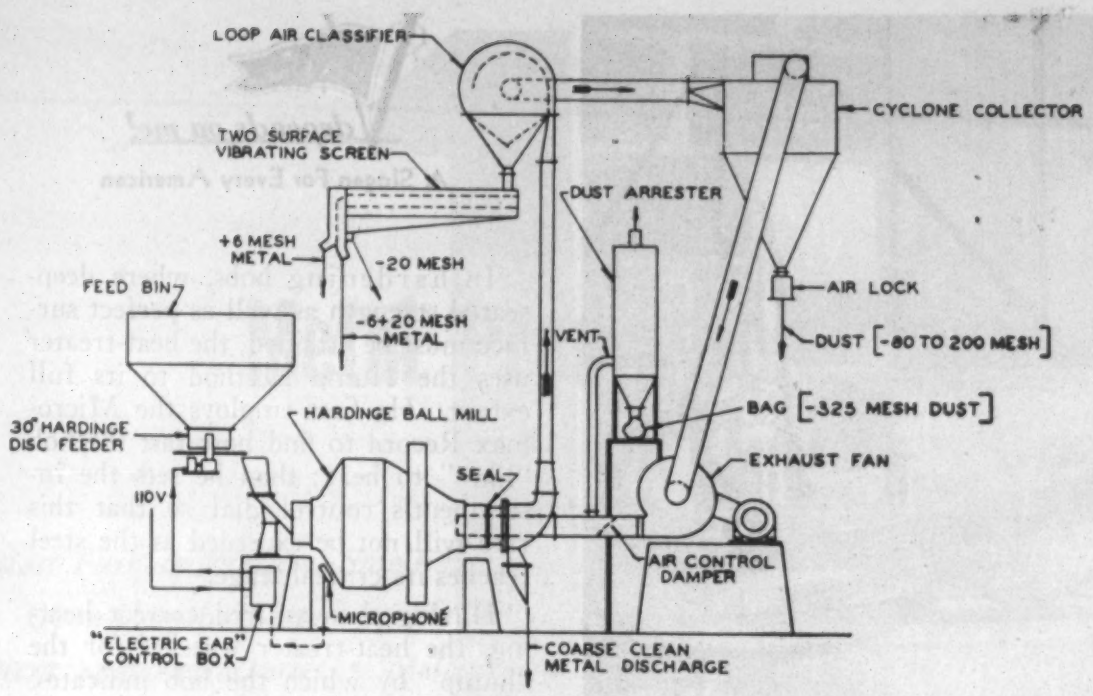
A PRODUCTION LINE APPLICATION

Automatic controls which the foreman sets, and which hold the Vapocarb-Hump just as he wishes, make this method of hardening ideal for women operators. This scene is in a large Canadian plant.

LEEDS & NORTHRUP COMPANY, 4925 STENTON AVE., PHILA. 44, PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES



For the recovery of Aluminum and Magnesium from Dross and Skimmings

The flow sheet shows a dry grinding unit producing six product sizes.

Complete recovery

Minimum of fines

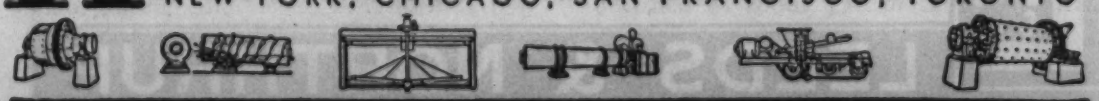
No dust hazard

Write for new bulletin 8-A

HARDINGE

COMPANY, INCORPORATED – YORK, PENNSYLVANIA

NEW YORK, CHICAGO, SAN FRANCISCO, TORONTO



decrease with increasing rolling up to 30%, then increase up to 80%, decrease slightly, and finally increase again. The earing at 45° is associated with preferred orientation, and the direction is that at which the tensile strength is at a minimum.

All series show a change in the position of the ears at 80 to 90% reduction coincident with the change in the type of recrystallization and again corresponding to the direction where the tensile strength is a minimum (in series A and B, 4 ears at 55° and 125°; in series C, 6 ears at 0°, 60° and 120° with only the latter two well developed).

The extent of earing for any given reduction increases with the magnitude of the final annealing temperature except for the samples from series C, which did not show earing at low reductions.

—M. Cook & T. L. Richards. *Inst. of Metals*, Paper No. 948, 1943, pp. 351-371.

Heating in Wire Drawing

Condensed from "Stahl und Eisen"

Very careful investigations of the heating and the heat distribution in wire drawing established the fact that an extremely high temperature gradient occurs in the surface layer of the wire during drawing, which is equalized rapidly behind the drawing nozzle.

The phenomenon is investigated theoretically, and it is shown that the energy of deformation in drawing leads to a practically uniform heating of the drawn material, while the temperature increase produced by friction is limited to a thin outer layer.

The temperature increase at the surface is proportional to the friction coefficient and the average deformation resistance of the material, and to the square root of the product of drawing velocity and length of nozzle. Little heat is conducted away from the nozzle because of high drawing velocities, as compared with the heat remaining in the wire.

—E. Siebel & R. Kobitzsch, *Stahl u. Eisen*, Vol. 63, Feb. 11, 1943, pp. 110-113.

Carbon Refractories

Condensed from "Iron Age"

The use of carbon refractories in blast furnaces has thus far been limited to European practice. In Germany, France, Belgium, Italy, Sweden and Russia, which are not important producers of iron, carbon refractories have been used in blast furnace linings for many decades.

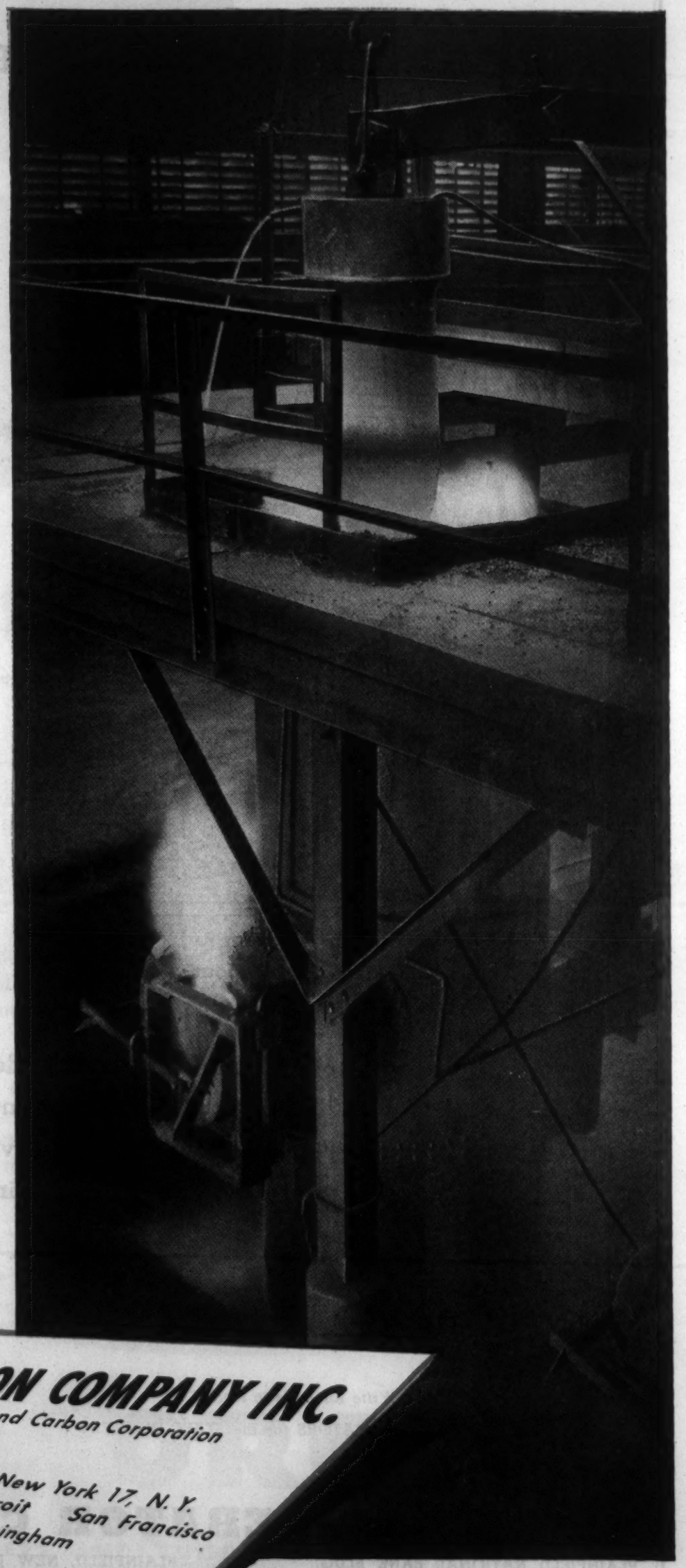
The relation between prices of firebrick of blast furnace quality and machined carbon blocks is approximately 1 to 2.5 per unit of weight or 1 to 1.7 per unit of volume in Europe. Nevertheless, carbon lining is considered more economical.

Carbon refractories used in the manufacture of phosphorus and calcium carbide in this country are similar in chemical and physical properties to the European blast furnace blocks.

Carbon refractories contain about 6 to

Number 1 of a Series: "Looking at the 5 essential things you never see in electrodes"

What's Cooking?



THERE'S PLENTY COOKING! Inside this electric calciner there are more things than just coal. And in every single one of the many operations in our three-months-long process of making carbon and graphite electrodes, these things are present.

We call them "the five essential things you *never see* in electrodes": Raw materials selection, manufacturing experience, manufacturing control, continuing research, and customer service.

Because of these five essential things, "National" and "Acheson" electrodes for electric furnaces have become steadily stronger, longer lasting, more economical. Since 1922 the average cost of graphite electrodes has declined approximately forty per cent.

All electrodes look much the same. But the measure of electrode value is deep under the surface . . . in the "five essential things you never see." For a close-up of these things, we invite you to call or write our nearest office.

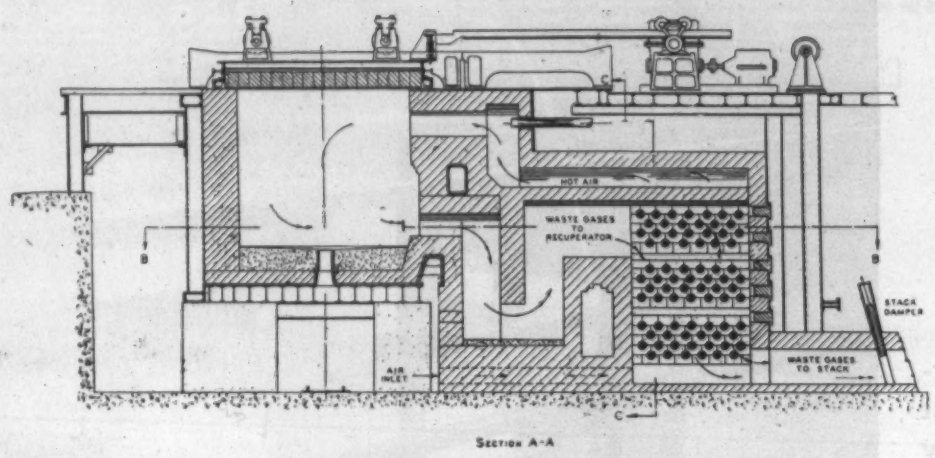
NATIONAL ELECTRODES — ACHESON GRAPHITE

The words "National" and "Acheson" and the "National" and "Acheson" Seals are registered trade-marks of National Carbon Company, Inc.

NATIONAL CARBON COMPANY INC.
Unit of Union Carbide and Carbon Corporation
UCC
ELECTRODE SALES DIVISION, New York 17, N. Y.
Niagara Falls Cleveland Detroit San Francisco
Pittsburgh Chicago Birmingham

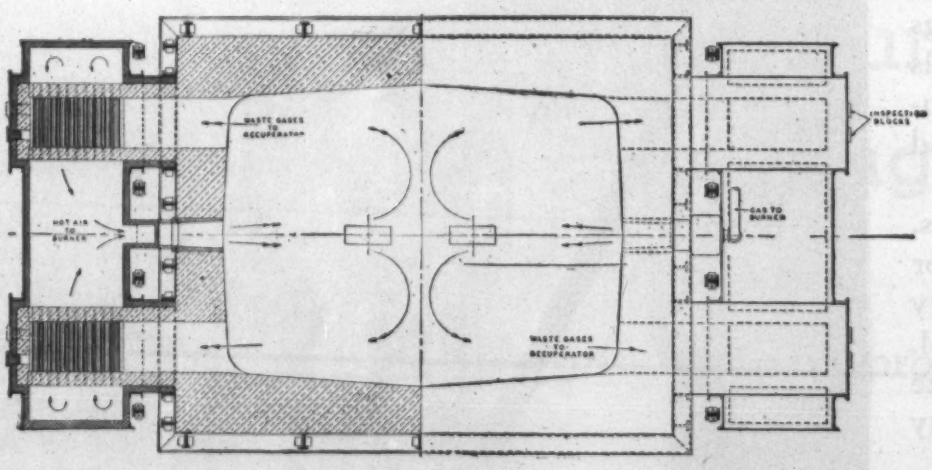
BUY UNITED STATES WAR BONDS

"FITCH" RECUPERATORS for SOAKING PITS



SECTION A-A

A single hole equipped with one recuperator.



A single hole equipped with four recuperators.

To date there are over 170 pits of various designs equipped with "Fitch" Recuperators. Many of these pits have replaced the regenerative type previously used, resulting in a greatly increased tonnage of steel heated.

WE DO NOT BUILD FURNACES

Write for Bulletin No. 12

"FITCH" RECUPERATORS for the STEEL INDUSTRY

FITCH RECUPERATOR CO.

PLAINFIELD NATIONAL BANK BLDG. PLAINFIELD, NEW JERSEY

8% of non-combustible matter, which has some influence on the volatilization temperature. Still, these carbon blocks or rammed linings do not soften at a temperature that would cause melting not only of super-duty brick but even pure thorium dioxide.

Ordinary firebricks soften under 50 lb. p.s.i. at 2370 to 2550 F. Super-duty firebrick will support a load of 50 lb. p.s.i. at 2800 F. or more. Carbon refractories have about the same mechanical properties at 3700 F.

In industrial application, refractories are exposed not only to mechanical and thermal stress, but also to chemical attack by solid, liquid and gaseous substances. At the high temperatures reached in hearth and bosh, firebrick will react with alkalies, oxides and other constituents in the furnace.

In spite of water jackets and cooling plates, erosion results. Carbon refractories, however, will not react chemically with any constituent of slag under any temperature and pressure.

For hearth and bosh of blast furnaces up to the mantle, monolithic and block refractories are used in high-grade foundry. Coke and tar are the raw materials from which prefired carbon refractories and ramming mixes are made. It is crushed and ground to grain size corresponding to U. S. standard sieve No. 18.

Coal tar with high non-volatile carbon yielding coke residue of high density forms the binder. To increase density and strength of refractory, pitch, petroleum asphalt and other bituminous substances of high melting point are dissolved in the hot tar.

Pastes for Linings

Pastes for monolithic linings are made from 5 to 6 parts of coke to one part of tar-pitch mixture. Raw materials are heated to 250 to 300 F. After mixing, hot paste is rammed into place in layers 1½ to 2 in. thick.

During installations of monolithic lining, men have to be provided with respirators to protect them against noxious fumes. Only skilled men are capable of ramming good lining.

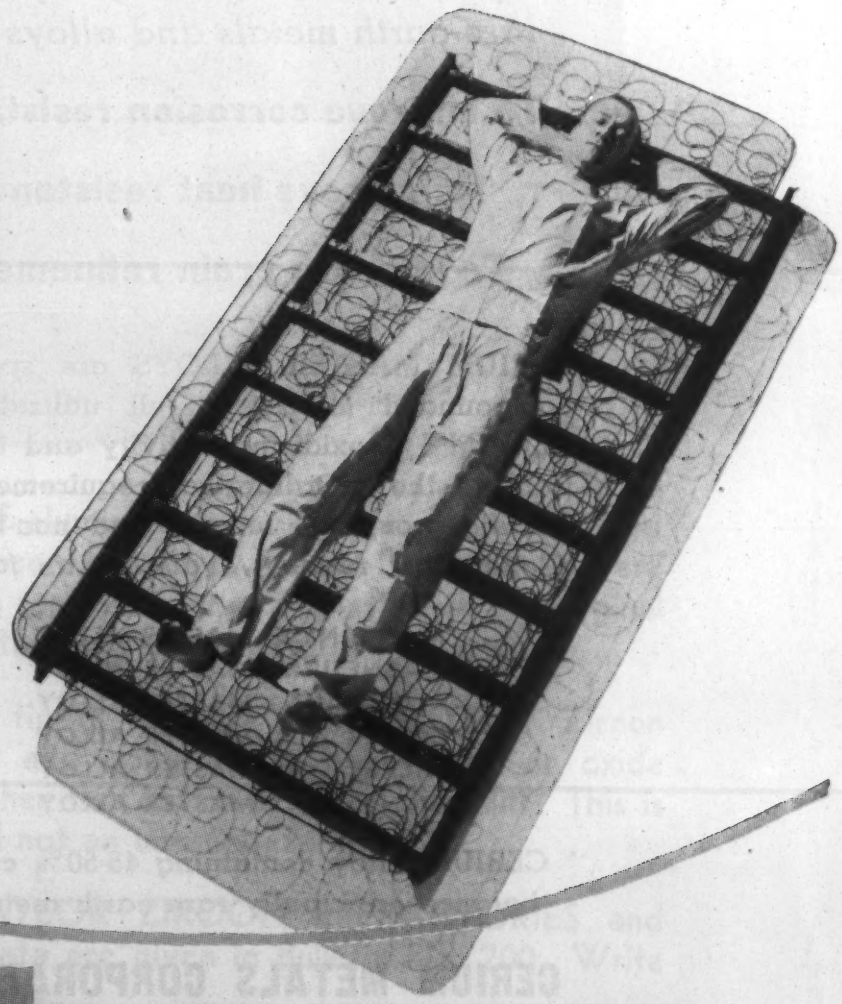
Another lining used in Europe is a prefired lining built of machined blocks. Key-shaped hearth blocks in lengths of 7 ft. or more weigh about 3000 lb., and smaller ones about 800 to 1000 lb. are used for the lining of the crucible.

The paste used for prefired blocks is coke and tar. Mixed in heated apparatus, the paste is molded immediately. Firing temperatures are 1922 to 2012 F. Linings built from these blocks are considered jointless. Its advantages are higher strength and heat conductivity.

Even though carbon-lined furnaces are known to have produced more iron than firebrick lined furnace, no proof is available that carbon lining lengthens life of blast furnace. Carbon lining offers a series of other advantages, and the sum total of these advantages seem to outweigh the increase of initial instalment cost.

Probably the most important advantages are the safety and reliability of a lining that has none or at least fewer joints than the fireblock lining, is not corroded by

Another 10% for Mr. Longfellow



. . . and many extra miles of wire rod!

We *long fellows* may never realize the 7-foot bed spring! But in any event, the post-war demand for prewar products promises a new prosperity based upon *more* tonnage, *greater* accuracy, *lower* costs.

Even a bed spring can be produced better, faster and cheaper if the cold drawn spring wire starts with a wire rod that is uniform in size and quality.

Plan with Morgan now for higher tonnage at lower costs . . . for the retooling and rebuilding of war-worn mills . . . for the installation of that new, improved Morgan Continuous Rolling Mill for rod, skelp and merchant shapes . . . or the new Continuous Wire Drawing Machines.

MORGAN CONSTRUCTION CO.
WORCESTER, MASSACHUSETTS

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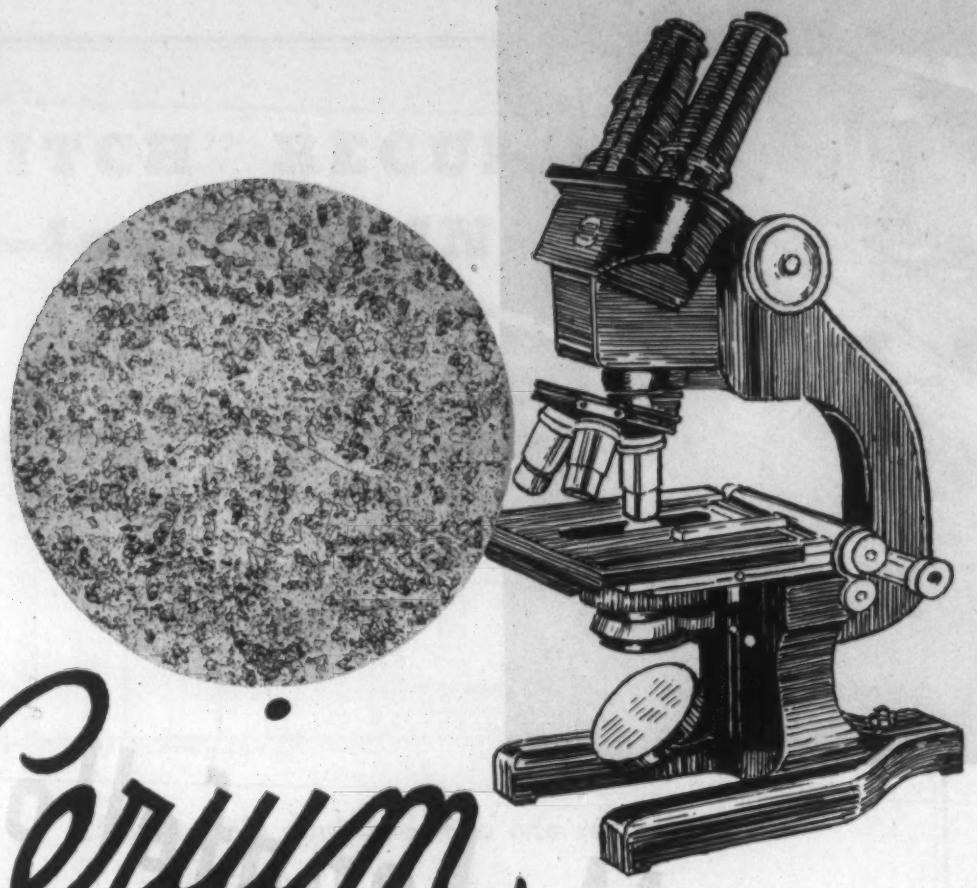
PLAN NOW WITH **MORGAN**

ENGINEERS AND BUILDERS OF ROLLING MILLS . . .
WIRE MILLS . . . REGENERATIVE FURNACE CONTROL



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ALLOY*

Investigate the CERIUM group of versatile, rare earth metals and alloys . . .

To improve corrosion resistance

To improve heat resistance

To improve grain refinement

CERIUM MASTER ALLOYS are specially compounded to permit full utilization of CERIUM'S deoxidizing activity and to conform to the metallurgical requirements of specific groups of ferrous and non-ferrous alloys. *Now readily available as follows:*

MANGANESE	MASTER ALLOY
MAGNESIUM	MASTER ALLOY
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IRON	MASTER ALLOY

* CERIUM alloy containing 45-50% cerium, balance principally rare earth metals.

CERIUM METALS CORPORATION

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CERIUM MASTER ALLOYS

INGOTS • POWDER • RODS

slag or metal, or may be cooled very intensively. With an increase in hearth diameters, losses of iron through the hearth are more severe. The carbon lining eliminates these losses almost entirely.

Although carbon refractories do not react with slag or metal, mechanical erosion and abrasion of the carbon lining take place, and iron does become embedded in the carbon hearth. A salamander in the carbon-lined furnace, however, does not even reach the firebrick base on which the carbon lining is laid, and losses of iron through the hearth are avoided.

The initial difference between costs of fireclay and carbon lining is further decreased not only by savings in time and labor, but also by the salvage of entirely unchanged or only slightly damaged carbon refractories.

—Josef M. Robitschek, *Iron Age*, Vol. 150, Feb. 1944, pp. 48-53.

Fine Die Production

Condensed from "Wire and Wire Products"

Progress made by the diamond die industry in the unknown and microscopic field of fine dies has surprised even the most enthusiastic. Two years ago, only rare and exceptional dies below 0.0015 in. were produced in the United States, while today production is on a regular basis in adequate numbers to supply the fine wire needed in our communication equipment.

France was formerly the center of the fine die industry. Importation of these ceased because of the war. Into this breach stepped the WPB to encourage the die makers of the U. S. to meet the situation.

Several companies had made experimental fine dies, and enough had been done so that the die industry knew the problems involved and the difficulty of making a reasonable return for the large amount of labor involved.

The WPB, therefore, decided not to subsidize the industry, as in England, but to stabilize prices at a level where a reasonable profit could be expected. Amazing progress has been made, but the task has not been simple.

The manner of achieving fine die production has been considerably different in the shops of the East than that used in the industry at Fort Wayne, Ind. Shops there had produced small dies for years; the shops in the East had devoted their efforts to larger dies and their machinery was completely inadequate for fine die production.

Therefore, new equipment was devised, and an effort made to place the manufacture of fine dies on a more automatic basis. The perfection rather than production of the fine die is the present aim of the industry.

The problem of producing a front, called primary and secondary cones by industry, with a smooth surface and a regular angle is pretty well under control as the result of a machine devised for this purpose and in use in the majority of die shops today. However, the production of the very fine yet all important "bearing"

Taylor ZIRCON

for

ALUMINUM OPEN HEARTH FURNACE BOTTOMS

Section thru Taylor Zircon bricks enlarged to Twice Actual Size to emphasize the "weld-like" joint of Taylor Zircon #701 Cement.

Unretouched photograph

16,000,000 lbs. of aluminum foundry returns were melted on the Taylor Zircon hearth of which these bricks were a part. Specimen removed for examination — the original Taylor Zircon bottom and side wall is still in service.

Note the clean, tight, weld-like joint of Taylor Zircon No. 701 Cement and complete lack of metal or oxide penetration in either the Zircon Brick or the joint. This is characteristic and not an unusual example.

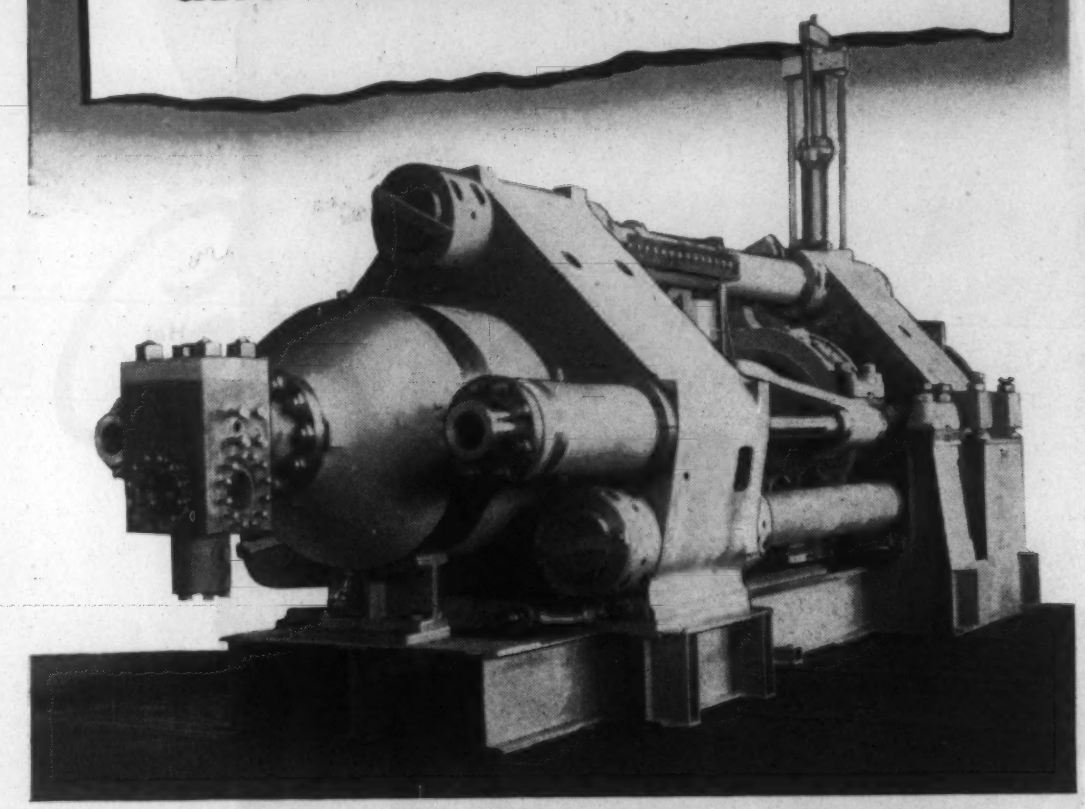
Properties of TAYLOR ZIRCON REFRACTORIES and other pertinent data are given in Bulletin No. 200. Write for your copy today.

TAYLOR — TAYLOR P B SILLIMANITE

CHAS. TAYLOR SONS Co.

MANUFACTURERS OF REFRACTORIES • CINCINNATI • OHIO • U. S. A.

SCHLOEMANN
Extrusion Presses . . .
Low Operation and Maintenance Costs



2500 ton Rod Press with new type cylinder construction. Forged steel cylinder is inserted in cast steel cylinder housing.

★ Unique design features of Schloemann Extrusion Presses permit the non-ferrous industry to produce tubular products, rods, bars, all kinds of sections, strip and wire rod with minimum operation and maintenance costs. Schloemann presses, ranging from 1000 to 5200 tons capacity, are readily adaptable to a diversified line of products with a great range of sizes. Operation economy is due largely to the reliable heat control as well as the uniform wall thickness which can be maintained in tubes without frequent readjustments of tools or machinery parts. The Schloemann Engineering Corporation also designs and engineers air hydraulic accumulators, accumulator controls, and complete hydraulic systems.

SCHLOEMANN
ENGINEERING CORPORATION

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HYDRAULIC PRESSES • ROLLING MILL MACHINERY

in a precise and accurate manner is yet unsolved. That it will be is extremely probable.

Another problem as yet facing the technicians in the industry involves the back of the die. If the American die industry can achieve a narrow shape in the back that will support the bearing after the die is recut to a larger size, it will have made a definite improvement in the art.

The achievement of a satisfactory polish or finish to the die is a phase in which further improvement can be expected. The preparation of the diamond powder used to achieve a high polish is a considerable factor, as it is likewise in the drilling operation.

Methods of preparation are trade secrets and carefully guarded; good powder is of primary importance. It can be said definitely that the polish of the domestic fine die has improved immensely since the first ones were produced.

Careful selection of the diamond is another important factor in the manufacture of fine dies. The quality of the stone now used in the domestic die is considerably superior to that used by European producers. After all the energy and labor expended in this field, our die makers do not intend to relinquish the fine die field. In a free market competition they intend to stand on their own feet and compete successfully.

If the Government protects the domestic fine die industry from foreign producers, it will be a just award.

—W. C. Moses. *Wire & Wire Products*, Feb. 1944, pp. 118-119, 142.

Blast Furnace Bedding

Condensed from "Iron and Steel Engineer"

Every metallurgical process is necessarily based upon the assumption that the materials used are of uniform composition, or vary within limits so narrow that routine corrections can be made. This is not always the case. Variations sometimes become extreme, and a system of bedding of ores or coking coal must be used to secure uniformity.

The operation of bedding consists essentially in distributing material along one axis of a pile or bed, the distribution being effected by a continuous reciprocating motion along this axis. A belt conveyor with a tripper might be used. Reclaiming is effected by removal of material on successive sections transverse to the bedding axis.

In mining, a mineral bed of iron ore generally consists of a mechanical mixture of the valuable constituent with one or more gangue minerals. Similarly, in the case of coal there are recognizable variations through the seam. In many cases it may be that the cost of mining and bedding is less than that of selective mining, with better metallurgical results.

The pioneer installations for accurate bedding and reclaiming were of the Robins-Messiter type. Installations as made today include two machines, one for

Foundry Alloys

offered by the

MOLYBDENUM CORPORATION OF AMERICA

are the results of thorough research

MCA

have been proved in war-time use

FERRO-BORON
BORON DEOXIDIZERS
BORIDE DEOXIDIZERS

FERRO-MOLYBDENUM
MOLYBDENUM OXIDE
CALCIUM MOLYBDATE

FERRO-TUNGSTEN
MOLYBDENUM AND TUNGSTEN METAL POWDERS

CHEMICALS OF MOLYBDENUM . . . TUNGSTEN . . . BORON

Unsparing effort in research and constant study of results among users have enabled the Molybdenum Corporation to produce alloying materials that are everywhere approved. The technicians of the Corporation are prepared to give advice on the varied uses of Molybdenum and Tungsten in iron and steel. They are widely consulted on the newly discovered uses of Boron in malleable iron, cast iron, and cast steel. The Corporation has developed and patented a special Ferro-Boron which dissolves easily in molten metal and gives a high recovery. Your inquiries will receive thoughtful attention.

MOLYBDENUM CORPORATION OF AMERICA
GRANT BUILDING **PITTSBURGH, PA.**

Applied like paint with a brush or gun

The highly--glazed surface produced and maintained with Brickseal is the secret of its unusual performance with any type of refractory.

Unlike air-set washes, Brickseal consists of high-fusion clays and metal oxides combined in oil. Brickseal is applied with brush or gun, and the unit may be fired at once. Furnace heat burns off the oil and vitrifies the clays and metals, forming a highly-glazed, air-tight, monolithic coating integral with the refractory. At operating temperature Brickseal becomes semi-plastic so that it cannot crack, peel or blister due to sudden temperature variations.

The glazed Brickseal surface reflects radiant heat, and is immune to gases, acids, alkalis and unignited fuel. It fills old cracks and binds loosened brickwork. Clinkers and slag may be removed without damage to lining.

Brickseal assures you of longer refractory life, reduced maintenance, and more production with less fuel, all at very little cost. Write for Brickseal sample.

BRICKSEAL
REFRACTORY CO.
1029 CLINTON ST., HOBOKEN, N. J.

stocking and the other for reclaiming, together with the necessary belt conveyors, transfer cars, and other auxiliaries.

The operation is in batches, and the beds are made and used in pairs, one bed being stocked while the other is being reclaimed.

Ore comes by belt from the sources of supply, and is tripped onto the stocking belt that runs between each pair of beds. The stoker spans this belt, and runs on rails, so that one stoker can be transferred to any stocking track. The reclaimer can also be transferred from one reclaiming track to another.

The reclaiming machine consists essentially of a carriage running on rails that extend along either side of the pile. A metallic conveyor equipped with plow-shaped members carries the reclaimed ore to one side, then to a point where it is discharged onto a longitudinal conveyor running in a trench below the yard level. This conveyor discharges onto the main reclaiming conveyor.

As now designed, nearly one thousand tons of iron ore can be stocked per hr. with one stoker. A reclaimer will handle 450 tons in accordance with design figures, but its actual capacity is nearly 600 tons per hr. The Robins-Messiter system has shown itself capable of producing a practically perfect technical result, and to be convenient and economical in operation.

Where this system is not usable because of climatic or other conditions, bedding may be accomplished by low level conveyor discharging onto a revolving yard crane with bedding conveyor running along the boom. Material may be deposited in parallel windrows. Reclamation is by power shovel or other loader.

Silo systems, with bins filled from a continuously moving tripper, also control the quality of the material. Reclamation is effected by emptying the bins in series. Another method is to fill the silos in series and empty in parallel.

Continuous bedding can be accomplished by stocking and reclaiming in a single bed, when the mineral shows no progressive variation. Bedding is done along a plane that makes a vertical angle with the angle of reclaiming. The system has also been applied to coking coal in a 7000-ton bin.

—A. J. Boynton. *Iron & Steel Engr.*, Vol. 21, Jan. 1944, pp. 66-74.

Alumina from Clay

Condensed from "Chemical Industries"

Under present domestic and political conditions, production of alumina from clay cannot possibly become much of a factor in U. S. production of aluminum until 1946 at the earliest, divesting the whole Government program of any important war significance. Alumina from clay can be of wartime value only if the European battle is still in progress in 1946.

Reopening of the clay program, however, again focuses attention on the several processes involved, their characteristics and relative advantages and disadvantages. The three developmental plants to be erected with Defense Plant Corp. funds are those

For CLEAN STEEL and INCREASED PRODUCTION

- **Lunke-Rite**—an extremely effective exothermic, powdered compound for the control of piping in steel ingots poured *with or without*, hot tops; and in steel castings. It increases ingot yield considerably. The additional heat created has a beneficial effect on quality of steel by reducing rate of cooling in center section of ingot, which has been found to prevent internal cracks and laminations. This fact is especially important for large forging ingots.—Also used for fitting ladle stopper into nozzle;—as cover on steel in ladle where duplexing or reladling is practiced;—as cover on hot metal being transported a distance from blast furnaces;—etc.—LUNKE-RITE is available in grades to suit various needs. Information upon request.
- **Rite-Melt Cleanser**—containing no aluminum—placed on bottom of ladle or into stream or on bottom of mold.
- **Rite-Sulphur Reducer**—put in ladle.
- **Rite-Moldcote**—for steel ingot molds—can be easily sprayed and is economical to use.

CONRAD WOLFF

Manufacturer—Owner of
The Rite-Products Company
Irvington, N. J.
P. O. Box 448 . . . Newark, N. J.

Additional Products:

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Finest levigated alumina

Green-Rouge Polish
Levigated Chromic oxide

Mild Polish
Levigated tin oxide

Sharp Polish
Levigated cerium oxide

● Efficient, economical fettling of an electric furnace calls for a smaller-sized refractory than the standard open hearth clinkered dolomite. Syndolag was designed to meet that need. It is a rice-size material, of sharp angled grains, carefully proportioned as to size and free of fines.

Since its introduction in the rice-size two years ago, Syndolag has grown steadily in favor in electric furnace shops. Operators who use it like it for these unique properties:

1. Sharp angle of repose—The small, angular grains stay in place well on steep slopes, instead of rolling down the banks to pile up around the edges of the flat. This cuts down fettling time, reduces refractory consumption and protects the capacity of the furnace.

2. Rapid heat absorption—Small grains absorb heat more quickly than larger grained material. This is especially important in the electric furnace where only residual heat after tapping is available to set a refractory.

3. Quick consolidation—Syndolag's small grains set up quickly into a dense, homogeneous patch which does not cut out readily or loosen easily—a valuable asset for top charged furnaces.

Syndolag has the same desirable chemical and mineralogical properties that have made Magnefer so successful for open hearth maintenance. Both refractories are produced at our modern plant in Northwestern Ohio, located near the geographical center of the steel industry. Adequate stocks are maintained, so that we can take care of your immediate needs with prompt rail shipments.

BASIC FURNACE
REFRACTORIES

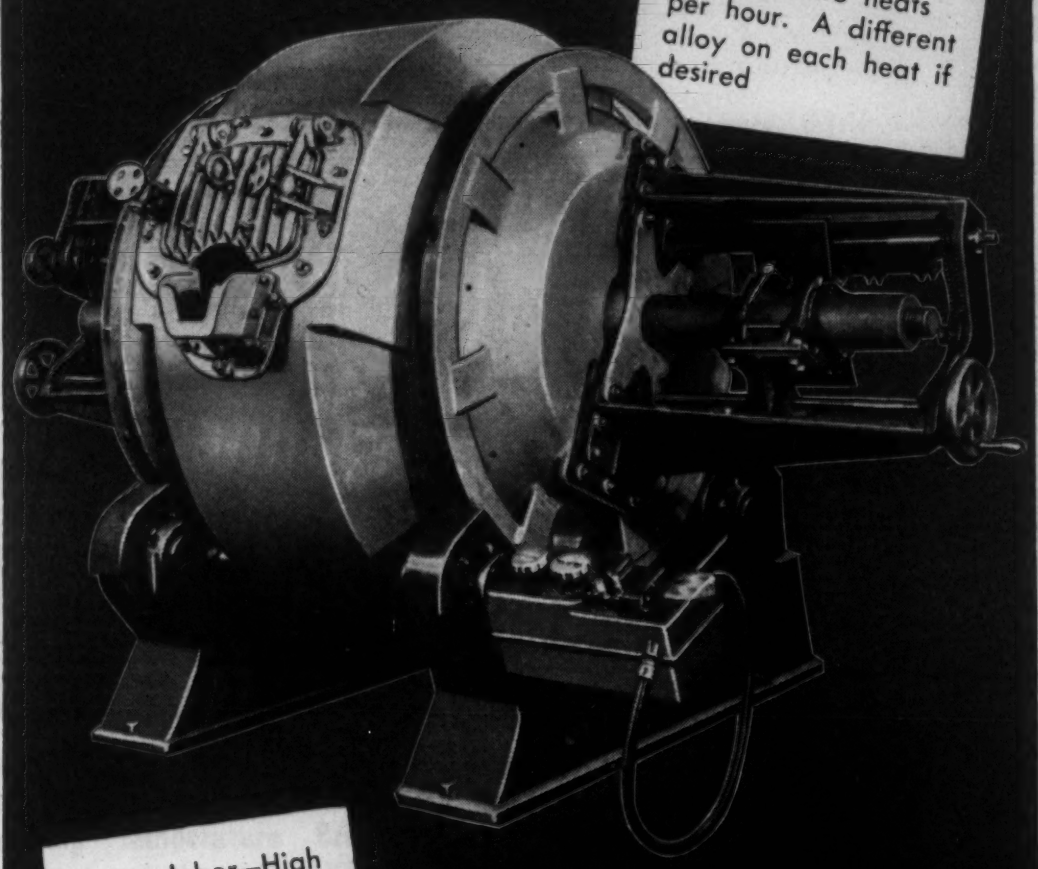
BASIC REFRACTORIES, INCORPORATED *Cleveland, Ohio*

There are many advantages to a Detroit Rocking Electric Furnace

Tested and Proven—For 25 years—Over a thousand installations operating throughout the world.

Versatile—In highly successful use for most commercial alloys—ferrous and non-ferrous.

Fast, flexible, efficient—One to two heats per hour. A different alloy on each heat if desired



Saves labor—High rate of production per man hour

Saves fuel—No fuel to handle or store Highly economical in the use of electric energy

Saves metal—Lowest metal losses in melting. Utilizes salvage materials direct in foundry charges

For all around economy and better quality you can't beat a Detroit Rocking Electric furnace. Available in a variety of capacities from 10 to 8,000 lbs. Write us today for further facts.

DETROIT ELECTRIC FURNACE DIVISION
KUHLMAN ELECTRIC COMPANY • BAY CITY, MICHIGAN

of Ancor Corp. in S. Carolina, operating on local kaolins; Columbia Metals Corp. at Salem, Ore., which will use Pacific coast clay; and Monolith Portland Midwest Co., using feldspar at Laramie, Wyo.

The Ancor Corp. will use the lime-soda-sinter process. This consists of first working crushed limestone and mashed kaolin clay in a tube mill, a little over 2½ tons of limestone being required per ton of clay.

The mixture from the mill is filtered, and the clay and limestone cake calcined in a rotary kiln, driving off the carbon dioxide. The sinter is leached with sodium carbonate solution, which gives sodium aluminate contaminated with silica — a product suitable for processing in a Bayer plant such as is now in use by the Aluminum Co. of America.

The Monolith Portland Midwest Co.'s process is similar to this one, both coming under the heading of alkaline processes. Also similar is the red mud reclamation process developed by Alcoa for recovering alumina carried down with the silica when the Bayer process is used on bauxite.

Sulphate Process

The Columbia Metals Corp. will use the ammonium sulphate process, developed by the Bureau of Mines and others. Clay and ammonium sulphate are roasted together to form alum and ammonia.

The alum is leached out of the sinter with water, leaving the insoluble silica, and then purified by recrystallization. This recrystallized alum is then combined with the recovered ammonia to give aluminum hydroxide which in turn is kiln dried to alumina.

Another process that has received Government recognition is the Kalunite process, to be used by Kalunite, Inc. near Salt Lake City. In this process, alunite ore, which contains basic alum and potash, is leached with cycle sulphuric acid of about 10% strength, giving potassium alum, which is crystallized.

These crystals, when placed in an autoclave at 150 lb. pressure and 94 C. (201 F.), decompose into basic alum and sulphuric acid again, but this time the basic alum has an alumina content of 33% as compared with 20% originally.

The regenerated acid, containing some of the potassium sulphate and about 15% of the alum, is recycled, while the rest of the alum that has crystallized is calcined at 1000 C. (1832 F.) to give alumina and potassium sulphate. The remaining acid (about half the original) is driven off as sulphur dioxide during the calcination.

Closely akin to the Kalunite process, but not yet approved by WPB, is the method developed by Phelps-Dodge Corp.

Still another process is one in which roasted clay is leached with concentrated hydrochloric acid, separating the alumina and iron from silica as aluminum and ferric chlorides.

Little can be said on the subject of the cost of alumina from clay. Some interested parties believe it can be brought within shooting distance of Alcoa's peacetime costs of $30 to $33 a ton.

—*Chem. Inds.*, Vol. 54, Jan. 1944, pp. 65.

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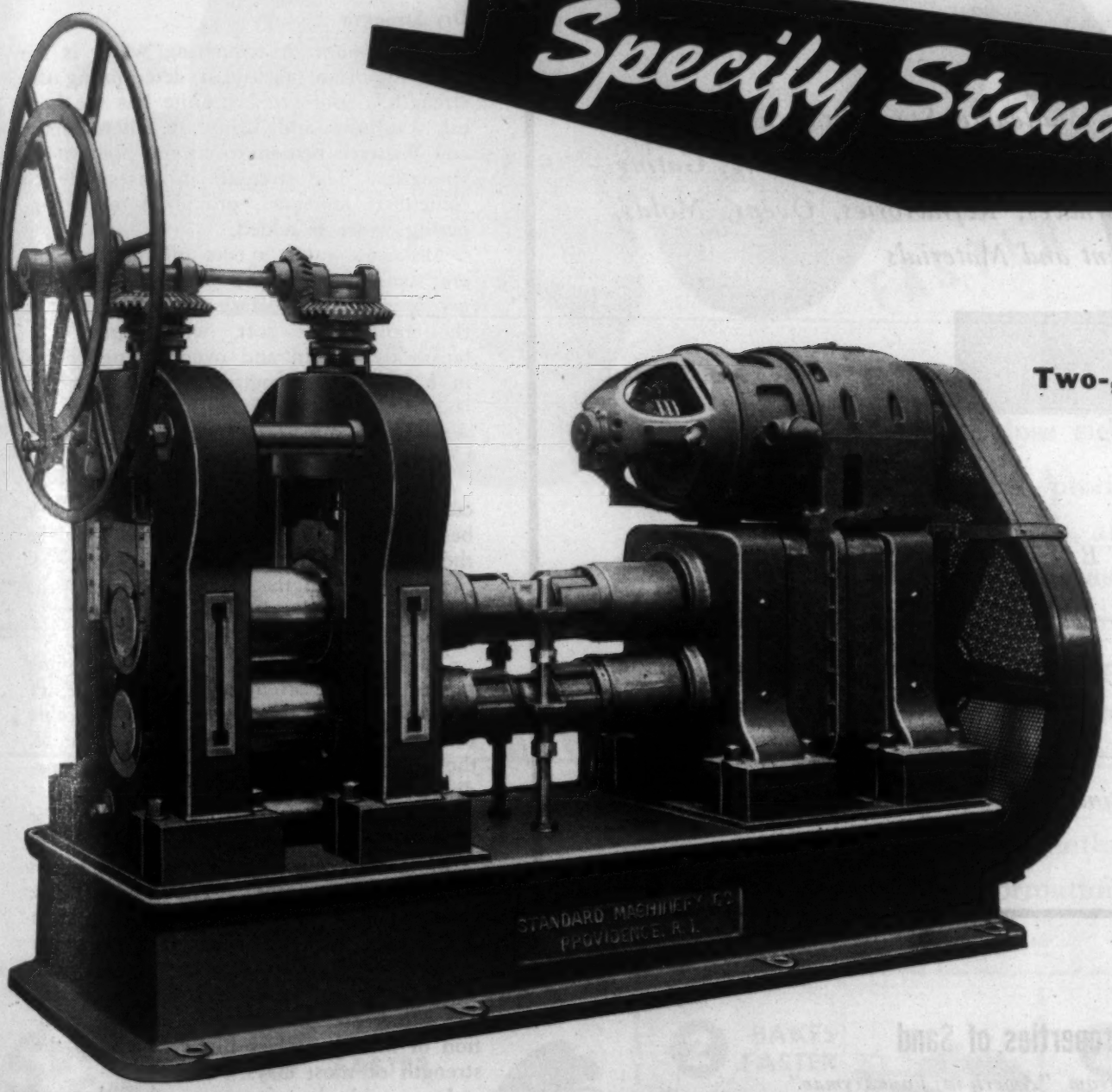

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Properties of Sand

Condensed from "American Foundryman"

Many casting defects are caused by good sand that is not properly selected for the particular job. Synthetic sand is flexible, and it is good economy to change the properties of the sand in accordance with the work. It is also reasonable to select the proper type bond clay.

As much of the clay as possible should be on the grains, not merely between the grains, which means that mixing should be extremely thorough.

Ideal conditions involve a small amount of clay and intensive mulling, perhaps best performed by a paddle type mixer, all of which results in higher permeability, less tempering water needed and higher flowability. Fire clay binders need the longest mixing; Western bentonite mixes fast but may form lumps; Southern bentonite mixes fast, with no lumps. Sand should be aerated after mulling.

The fairly common idea that water added to weak sand will make it stronger is incorrect — it makes it more workable, but weaker. If we ram a mold harder we increase the effective strength. Fines usually decrease green strength, since they increase the amount of tempering water needed, due to their large surface area.

Green strength is in general relation to the amount of clay used. The more clay, the more moisture needed to keep sand workable. Many foundries could reduce their clay addition if they simultaneously reduced their moisture content. Green strength can be increased by more thorough mixing, adding clay in the form of a slurry, reducing amount of tempering water, changing to a stronger clay, harder ramming, adding auxiliary binders and by adding more clay.

Dry strength (sample baked at 220 F.) increases with more efficient mixing at an even more rapid rate than does green strength. Also, an increase in the dry mixing time causes a sharp increase in dry strength. An increase in tempering water increases dry strength greatly. An increase in mold hardness sharply increases dry strength and so do fines.

Dry Strength

The amount of tempering water is the most important factor in determining dry strength. Southern bentonite has the lowest, kaolinite and illite are intermediate, and Western bentonite has the highest dry strength. The strength increases as clay content is increased, providing more tempering water is added.

Molasses water, a core oil mixture, etc. are sometimes sprayed on the mold face, giving a harder surface while the rest of the mold stays soft, with higher collapsibility. Skin and oven drying results in higher dry strength before pouring. It is worthwhile on valuable castings and essential on very large castings, offsetting unskilled labor.

Special dry strength bond clays usually contain from four to six ingredients. For best results it is essential that they be thermoplastics, or soften under heat between dry strength and hot strength, the latter being any strength measured at a temperature above 220 F.

The more intensive the mixing, the higher the hot strength. The amount of tempering water has a very considerable influence, the greater the water content, the greater the strength. At low and medium high temperatures, hot strength increases with mold hardness, though the effect is less pronounced at 2500 F.

More clay plus more water means much higher hot strengths. The type of clay used has more effect on that strength than any other factor. When most clays are mixed, hot strength increases rather gradually from the weaker to the stronger. Fines increase the strength, and the addition of most auxiliary binders step up the strength of most clays.

Iron oxide benefits core mixes because it reduces cracking and shattering of the core from heat shock when metal is poured. It may also set up higher hot strengths. Silica flour reduces penetration, makes a harder mold after drying and cooling, and increases the hot strength of bond clays.

Adding to Permeability

Permeability is the ability of a sand to vent gases and has no relation to the amount of gas to be vented. Water expands 1638 times in volume in changing into steam, which gives an idea of the pressure that must be relieved in venting this gas. Sea coal and other gas forming elements reduce permeability because of their bulk and add to the amount of gas to be vented.

Permeability decreases as mold hardness increases for the same sand. It may be

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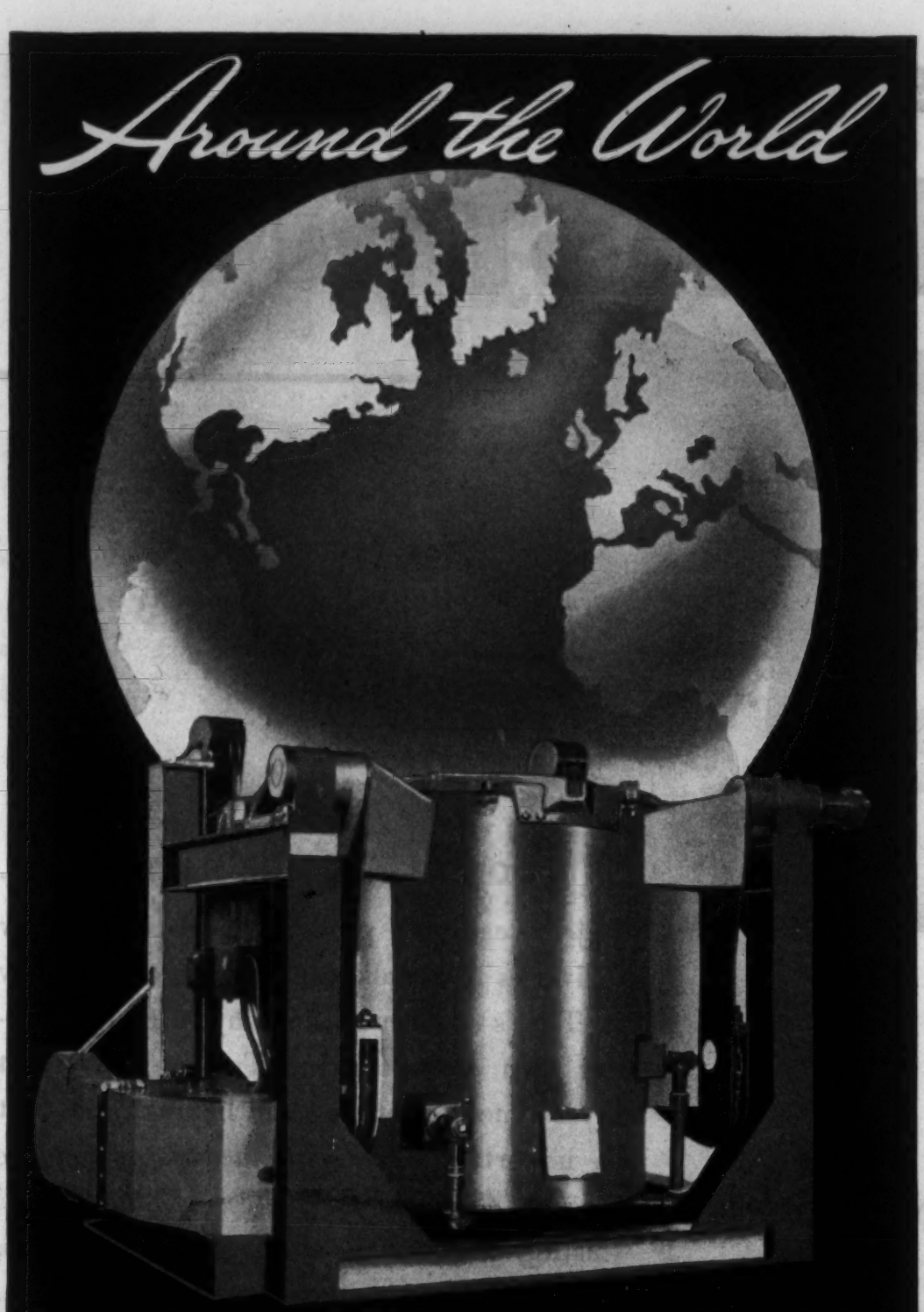

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adequate for a soft rammed job but too low for harder rammed work. Permeability decreases as thickness of sand increases. We must think of it in relation to the amount of gas to be evolved, the hardness of the mold and thickness of the sand.

It is not good practice to use solid flasks and solid bottom boards. Perforated flasks and boards often result in better finish.

Permeability usually decreases as the clay content increases. The type as well as quantity of clay has a most important effect on it. Usually permeability decreases as water content increases. With more efficient mixing, green strength increases and permeability decreases.

Skin or oven drying increases permeability, since it reduces the amount of gas to be vented. Skin dried molds usually give better castings than green sand molds.

Uniform distribution of grain size on a few sieves gives much higher permeability than a scattered distribution. Upon addition of coarse sand to open up a finer sand, no appreciable effect is obtained until 30% of the coarse grain has been added, but in closing up a coarse sand only 5 to 10% fine sand will be needed to substantially reduce permeability. Fines must be removed or diluted. Usual practice is the latter by the addition of sand that is low in fines.

Flowability Means Easy Ramming

Flowability is that property of sand that permits it to be easily rammed into a hard mold face with a minimum of effort. A soft, smooth feeling sand, usually has high flowability, while a sticky, gummy sand will have low flowability. It increases with thorough mixing; it is at a maximum in properly tempered sand; it decreases as clay content increases.

The type of clay is most important. Southern bentonite is best, illite and kaolinite are fair, and Western bentonite poor. Fines and sea coal reduce it. Resin binder increases flowability notably; pitch reduces it, and cereal binder reduces it faster than any other binder. Uniform grained synthetic sands have much higher flowability than do naturally bonded sands.

Deformation is the amount a sand gives or yields before it breaks. When deformation is multiplied by green strength times 1000, we get resilience or sand toughness. Deformation is increased by less thorough mixing, increasing water content, increasing clay content, selection of proper type of clay, and increasing sea coal, pitch or cereal binder.

In a synthetic sand we usually have expansion up to 1500 F., above which the clay starts to contract. Excessive expansion may cause rat tails, buckles, scabs and fins. Excessive contraction may cause scabs and fins.

Expansion increases as mold hardness increases. Expansion may be reduced by: Less intensive mixing, increased clay content, selection of proper type clay, reduced flowability by adding fines of cereal binder, increased sea coal, reduced water content, and reduced mold hardness.

Contraction may be reduced by: More intensive mixing, decreased clay content, selection of proper type clay, reduced fines and reduced water content.

Invitation to Non-ferrous Metallurgists

LIKE other non-ferrous metals LITHIUM has been marching in the ranks of those products which are serving the Armed Forces. Outstanding contributions have been made by Lithium, and its pre-war production capacities have been greatly increased. Thus the normal growth of a young industry has been considerably accelerated, and the post-war era will find Lithium available in quantity.

IT IS anticipated that production facilities now available will tend to reduce appreciably the pre-war prices for Lithium, thus making possible more extended and economical use. Eventually, quantity application at cost approximating one half or less of pre-war prices should be feasible.

ALTHOUGH the current requirements for Lithium make it still subject to WPB allocation, Lithium metal will now gradually become available again for metallurgical applications.

THE principal commercial applications for Lithium in the non-ferrous field have been in the form of Lithium Master Alloys as highly efficient degasifying (dehydrogenizing) and deoxidizing agents for copper and certain bronzes. The applications in this field have been successful because the unique physical and chemical characteristics of Lithium are utilized in a practical and simple manner.

THE Research Staff of the Lithaloys Corporation has been devoting its efforts also to the development of novel metallurgical applications in which Lithium performs the function of an essential though minor alloying constituent.

LITHALOYS CORPORATION HAS ENJOYED THE BENEFITS OF MANY YEARS OF PIONEERING WORK IN THE LITHIUM FIELD.

SUFFICIENT basic information on the unusual and metallurgically rather intriguing element Lithium can be made available to the interested metallurgical public. It is believed that by disseminating reliable information, active interest in Lithium will increase.

AN invitation is therefore extended to the non-ferrous and physical metallurgists to acquaint themselves with the chemistry and metallurgy of Lithium.

Printed information will be sent you on request.

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Other Qualities

The sintering point is the temperature at which sand fuses to a platinum ribbon. Sand that has a low sintering point will "burn on" to a casting. To increase sintering point: Use the strongest, most refractory clay available, use the stronger of two clays of equal refractory value, use a more refractory base sand, increase sea coal, and reduce fines.

It is desirable to have a sand that will maintain hot strength long enough to prevent cuts and washes, and then collapse to prevent cracking of castings. To increase this quality: Use proper clay or combination, reduce clay content, reduce moisture content, reduce mold hardness, and reduce pitch content.

To reduce lumpy sand at shakeout: Select proper type of clay, reduce clay content, reduce moisture content, shake out castings more quickly after pouring, and reduce sea coal content. To reduce the amount of tempering water: Reduce clay content, use stronger type of clay, and reduce amount of fines.

There is no method to increase the durability of a sand other than changing to a more durable clay.

—N. J. Dunbeck. *Am. Foundryman*, Vol. 6, Jan. 1944, pp. 9-12; Feb., pp. 8-12.

Good Riddance to Dust

Condensed from "Safety Engineering"

To eliminate shavings and sawdust from a pattern shop operated in conjunction with a foundry, and fine metal dust in nearby casting grinding departments, the R. K. LeBlond Machine Tool Co. utilizes two separate dust control systems.

In the pattern shop, suction pipes were installed with hoods around knives and saws. Pipes were joined together in a ceiling main, and this pipe was carried to a point 100 ft. away from the pattern shop. Here material is separated by an arrester-collector so that air may be returned through a separate duct to the inside of the shop in the shipping department. By this arrangement there is little loss of heat.

Air is blown downward directly above two outside doors so that in winter a curtain of air prevents cold air from entering the shop. Several barrels of chips and sawdust are collected daily.

The basic engineering feature of the down-draft exhaust system is the fact that dust is removed below breathing level. Installation was separated into three groupings.

The first group comprised three-foot-diameter tables with grading covers and hopper bottoms for small work. The next group covered larger tables to handle intermediate size castings, and one rectangular table for heavier and longer work made up the last class.

Dust is carried to a dispensing unit that separates dust from the air and discharges clean air into the outside atmosphere.

The above Ajax-Wyatt Furnace lined with "Shamva" Mullite had melted over 500,000 lbs. of high copper alloys and was continued in service after relining door. Note excellent condition of the secondary channels.

"Shamva" Mullite *increases our production!*

"Shamva" Mullite often gives 4 to 6 times the service life of refractories in common use. The resulting production gains are so substantial that no plant can afford to overlook the possibilities on non-ferrous, gray iron and steel foundry work, and open hearth operation.

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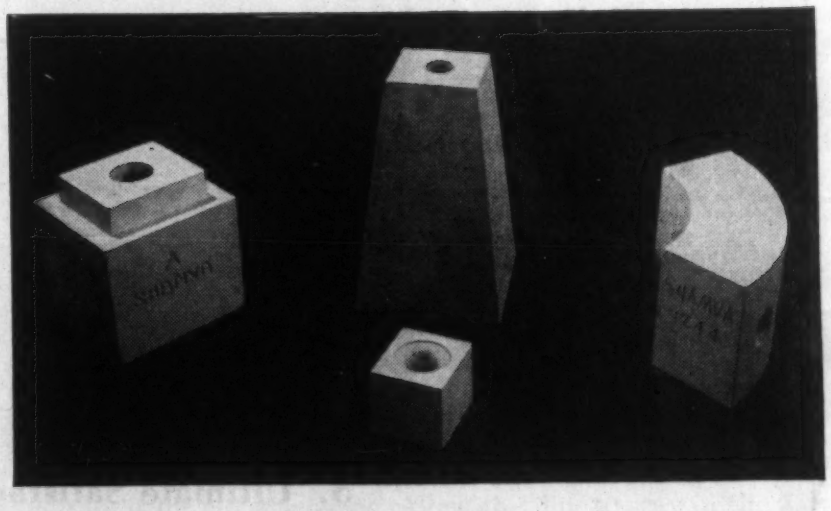

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Photograph Courtesy Fisher Furnace Company, Chicago, Ill.

Illustration shows one of the 2455* non-ferrous foundries in the United States using Crucible furnaces with the following advantages:

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4. Speed

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The unit is equipped with an after-cleaner to assure removal of all dust from the air. Metal dust from grinders is exhausted through floor and bench gratings, thus saving space.

—*Safety Engrg.*, Vol. 86, Oct. 1943, pp. 24-25.

Repair of Porous Castings

A Composite

The practice of using various materials for filling small pores in castings is an old one. War demands for huge production of sound castings, many of which must pass pressure tests, make these recent articles in British and American technical magazines of interest in comparing the practice in the two countries.

In England, the use of water or ammonium chloride solution for rusting the interior of automobile motor cylinders has been standard practice with many firms. However, war production has greatly increased the use of non-ferrous castings, for which this process was not generally applicable. Water glass, shellac, etc., have also been used.

Linseed oil was tried as a sealing agent in Great Britain, but it was found that the hardening of the oil, taking place on the surface, did not give the lead-tightness under pressure. Later, a Bakelite-type material was marketed which did a very successful job.

The porous casting must be treated with the sealing solution under pressure, and later baked. A varnish, in which the warmed casting could be immersed, was also developed, and both of these treatments are now standard British practice.

The sealing solution developed by Bakelite Ltd. is intended for non-ferrous castings, as bronze, gun-metal, brass and the light alloys, and is not necessarily suitable for use with cast iron. Porosity in the non-ferrous castings is generally much finer than in cast iron.

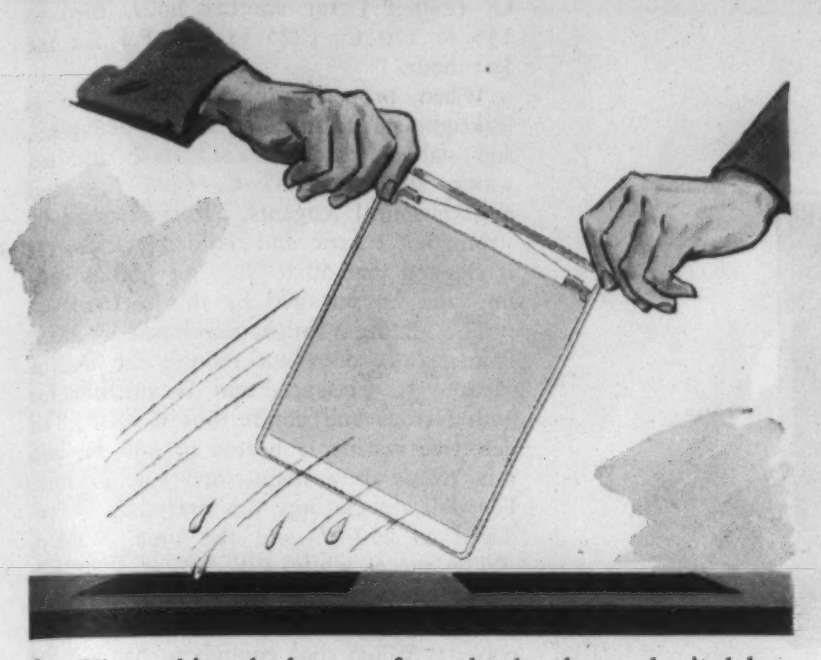
The solution is furnished in two types — a clear solution, V.1845, for use with castings with fine porosity, and N.2106, containing a silicious filler and recommended for pieces with more pronounced defects. As the method is not recommended for grossly defective castings, the first solution should be used whenever possible.

Applied with Pressure

Application of the material may be made by vacuum, with the castings in a suitable container, or by pressure, obtained with a hand pump or compressed air. The pressure method is favored in England. All exits on the casting are blocked, and the piece, if of large internal volume, is filled with scrap metal.

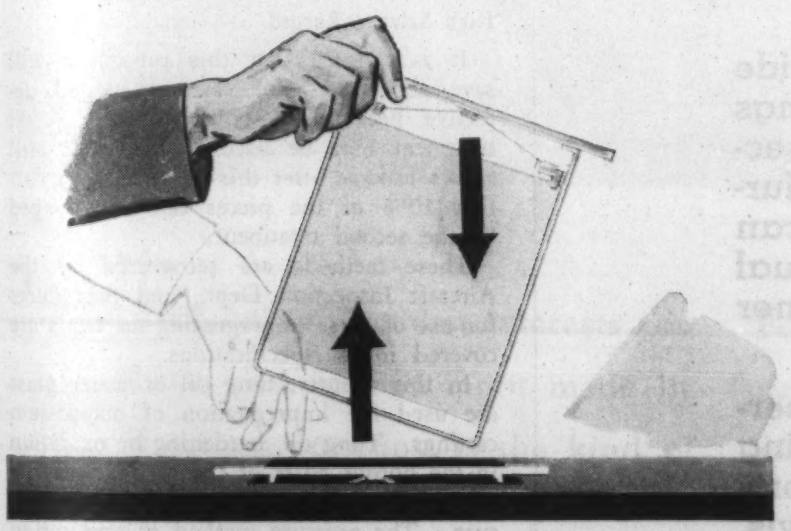
The solution is then added, and pressure, preferably obtained with a hand pump, is run up to 300 p.s.i. or higher. It is desirable that the solution be forced through the porous area to the outside surface.

The casting is then emptied, and excess solution removed as completely as possible

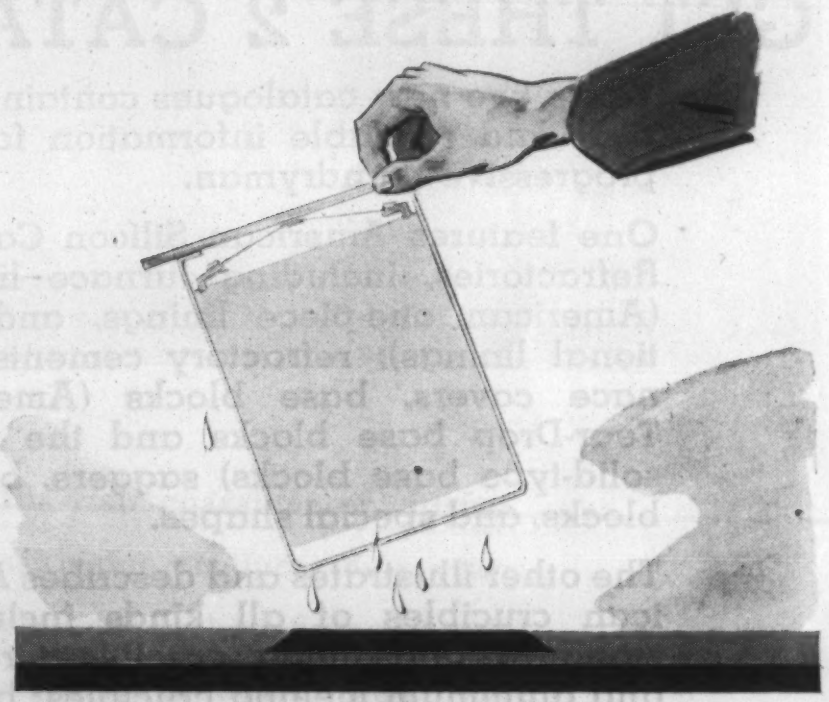


A few facts about RINSING and FIXING

1. When taking the hangers from the developer, don't delay in getting them into the rinse. Don't, for example, take this opportunity to inspect the radiograph before the safelight. If you keep the film out of the solutions for any length of time at this stage, it may become stained or streaked as a result of aerial oxidation.



2. The reason for rinsing the film in water is to remove as much of the developer as possible. Therefore, change the water frequently or, preferably, rinse in a bath of running water. *Merely dipping the film in the water is not enough!* You've got to agitate it vigorously at least half a dozen times. (Many technicians use a short-stop bath of 2% acetic acid instead of the water rinse—with excellent results.)



3. When transferring the film from the rinse to the fixing solution, try to carry over as little water as possible to avoid diluting the fixer. After you place the film in the fixer, agitate it for a few seconds. Allow the film to stay in the fixer twice the time it takes to clear. For example: if the film clears in three minutes, it should stay in the bath a total of 6 minutes. Don't turn on white light until the film has been in the fixer for at least a minute.

Watch for evidence of exhausted fixer. You can tell this by the appearance of foam on the surface or by a *bad odor*. Usually, a fixing solution is considered exhausted when it takes twice as long to clear film as when fresh. Follow these instructions carefully if you expect fine results. Remember: Incompletely fixed films deteriorate in storage.

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One features American Silicon Carbide Refractories, including furnace linings (American one-piece linings, and sectional linings); refractory cements, furnace covers, base blocks (American Tear-Drop base blocks and the usual solid-type base blocks) saggers, burner blocks, and special shapes.

The other illustrates and describes American crucibles of all kinds including standard and tilting crucibles; retorts and aluminum melting crucibles; bowls, teeming crucibles, funnels, pouring boxes, and special shapes. Full data and notes on the care of crucibles is included.

These catalogs will be very helpful to anyone who uses or buys metal-melting equipment.

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before polymerization occurs. The resin is then polymerized by heating to a temperature of 85 C. (185 F.) the first hour, holding for one hour, increasing to 110 C. (230 F.) for another hour, then to 135 to 170 C. (275 to 340 F.) for the last hour.

When properly applied, the piece is leaktight at pressures to about 5000 p.s.i., and stable to hot or cold fresh and sea water, steam to 205 C. (405 F.), and most chemical reagents. It is attacked by strong hot caustic and oxidizing acids. It is claimed that 50 to 70% of porous castings can be salvaged by this method.

The sealing varnish, developed by I.C.I. Paints, Ltd., does not require the use of vacuum or pressure, and is suitable for both ferrous and non-ferrous metals. The defective casting is heated to 300 F., and this temperature maintained for 30 min. For delicate castings the heat may be reduced to 250 F. and the time doubled.

The piece, while still hot, is then immersed in a bath of the varnish, and permitted to remain until all bubbling has ceased. When cool enough to handle, the casting is removed and surplus varnish is washed off in a bath of cleaning solvent 149-6. The work is then heated in an oven to 300 F. for about 30 min. to one hr., depending upon the weight of the piece.

High Salvage Record

It is claimed that this procedure will save about 85% of castings judged defective because of porosity. A second treatment may be used if the work still shows leakage after this treatment. A further 10% of the pieces can be salvaged by the second treatment.

These methods are recognized by the Aircraft Inspection Dept., and procedures for use of these impregnating materials are covered in its specifications.

In this country, tung oil or water glass are used for impregnation of magnesium castings. Tung oil, hardening by oxidation in the porous parts of the casting, may be applied by dipping, or by vacuum or pressure. The pressure method of application has been adopted by Chevrolet Gray Iron Foundry for its magnesium castings.

At this shop the pieces are heated to 350 F., placed in fixtures that provide feed lines for tung oil into the cavities of the castings and overflow lines at the other ends of the cavities, and the oil at 210 F. is run into the castings. When all the air has been driven out, the valves on the overflow pipes are closed, bringing the oil pressure in the casting to 90 lbs. This pressure is maintained for 10 min.

The pieces are then removed, run through a degreaser that removes oil from the surface, and allowed to stand for from 8 to 12 hrs., during which the tung oil in the porous metal is oxidized. Treatment in an oven completes the oxidation of the oil, the temperature being brought up to 350 F. over a 2-hr. period, and held at that point for 4 hr.

Pressure Test

The castings are cleaned by sandblasting, given a dichromate treatment, machined if necessary, and then tested at 250 lb. pressure. If porosity is still indicated,

KNOW HOW

THE only thing that interests you about non-ferrous ingot made by Michigan Smelting is the kind of castings you can make from it in your own plant. How accurately do we hold to your specifications so that wastage and spoilage will be held to an absolute minimum? On that point the "know-how" of this organization is important to you. For it is your guarantee of satisfaction with our product. Fifty years of experience in the refining of non-ferrous scrap, plus up-to-the-minute equipment, enable Michigan Smelting to make ingot to the most rigid and exacting specifications —a product that in many respects is superior to alloys of virgin metals.

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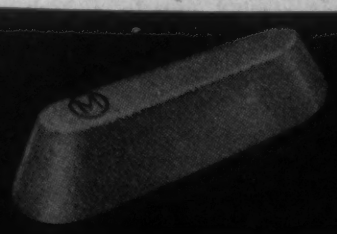

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General Offices: Lafayette Building

a second impregnation with the oil may be tried, usually by simple soaking or by the vacuum system. The casting is scrapped if the second treatment is unsuccessful.

Dow Chemical Co. several years ago developed the vacuum technique for impregnating magnesium castings. A tray of castings is placed in a vacuum chamber, a vacuum of 22 to 28 in. is secured to exhaust air in the pores of the pieces, and tung oil run in to cover the pieces. Air pressure of about 100 lb. is then introduced, and held for 35 min. to 1 hr. to force the oil into porous areas.

After removal, the work is given a kerosene rinse, then immersed in engine oil at 475 F. for 45 min. to set the tung oil. A second kerosene rinse follows, then degreasing of the work. A bake at 350 F. completes the oxidation of the tung oil.

The vacuum process is lengthy, requires considerable floor space, and consumes more tung oil, but is more adaptable to a variety of shapes of casting. The pressure method appears to give somewhat more satisfactory impregnation.

—*Iron and Steel*, Vol. 6, Nov. 1943, pp. 145-146; *Ind. Chem.*, Vol. 19, Nov. 1943, pp. 603-604; S. H. Brams. *Iron Age*, Vol. 152. Nov. 11, 1943, pp. 57-59.

Desulphurization of Cast Iron

Condensed from "Metallurgia"

The acid-lined (siliceous) ladles commonly used for the desulphurization of cast iron by sodium carbonate have several disadvantages:

(1) The desulphurizing reaction, Na S + SiO + MnO (FeO) = Na SiO + MnS (FeS), is reversible in the presence of an excess of silica.

(2) It is difficult to effect an appreciable desulphurization in iron having an initial sulphur content less than 0.04% and a silicon content less than 1.0%.

(3) Irons containing relatively low percentages of manganese are difficult to desulphurize.

Successful previous experiments in the use of basic linings were made in Germany and Luxemburg. The four lining materials tested were calcined dolomite, tar-bonded; stabilized dolomite (containing about 15% of silica); serpentine, water-bonded; and loam, water-bonded. (The last two are siliceous materials).

The irons melted in each lining were gray hematite pig iron, white hematite pig iron, and common gray iron. Melting was carried out in a high-frequency induction furnace. Approximately 2% of granular sodium carbonate was used for each treatment.

Experimental data indicated:

(1) The effectiveness of desulphurization with the various linings, in decreasing order, was calcined dolomite, tar-bonded; stabilized dolomite; serpentine; loam. Thus, the basic linings produced a greater degree of desulphurization than the siliceous linings.

A FEW FACTS ABOUT CORHART PRODUCTS

Corhart Electrocast Refractories are high-duty products manufactured by melting selected and controlled refractory batches in electric furnaces, and casting the molten material into molds. After careful annealing, the finished shapes are ready for shipment. Dense, high-melting refractories, they are especially designed for resistance to corrosive action.

PRODUCTS

CORHART STANDARD ELECTROCAST is a high-aluminous refractory.

CORHART ZED ELECTROCAST is Zirconia-bearing.

CORHART ELECTROPLAST is a high-temperature plastic refractory made from Standard Electrocast which has been ground and crushed. Especially designed for ramming. Furnished dry.

CORHART MORTAR is a high-quality cement for laying up Electrocast, clay brick, or any aluminous refractory.

CHARACTERISTICS OF STANDARD ELECTROCAST

POROSITY: Less than 0.5%—therefore virtually no absorption.

FUSION POINT: Cone 38 without any appreciable softening below that point.

HARDNESS: 8, Mineralogist's scale.

SPECIFIC GRAVITY: Blocks weigh approximately 183 lbs. per cu. ft.

COEFFICIENT OF EXPANSION: 0.000006 between room temperature and 900° C.

SPECIFIC HEAT: 0.25 cal. per gm. per °C. at 980° C.

THERMAL CONDUCTIVITY: 25 BTU per sq. ft. per hour for gradient of 1°F. per inch.

COMPOSITION: Standard Electrocast is of an aluminous crystalline nature.

CORROSION: Because of low porosity and inherent chemical make-up, Corhart products are highly resistant to corrosive action.

APPLICATIONS

Most heat processes present spots where a better refractory material is needed in order to provide a balanced unit and reduce the expense of repeated repairs. It is for such places of severe service that we invite inquiries regarding Corhart Products as the fortifying agents to provide the refractory "balance" desired.

The following is a partial list of applications for which Corhart Products are suggested:

ELECTROLYTIC CELLS — for production of Magnesium and other light metals.

SILICATE OF SODA FURNACES — sidewalls, bottoms, and breastwalls.

HEARTHS AND SMELTERS — for non-ferrous metals.

ALKALI AND BORAX MELTING FURNACES — fast-eroding portions.

GLASS FURNACES — the entire installation of flux walls and bottoms, breastwalls, ports, tuck-stones, forehearths, recuperators, etc.

RECUPERATORS—tile, headers, separators, etc.

ENAMEL FRIT FURNACES — flux walls and bottom.

BRASS FURNACES — metal contact lining.

ELECTRIC FURNACES — linings for rocking type, and rammed linings of Electroplast for this and other types.

BOILERS — clinker line.

STOCK SHAPES AND SPECIALS

Standard and Zed Electrocast are made in stock shapes and in many special shapes. The weight of individual pieces may run to 3500 pounds.

IF YOU NEED A BETTER REFRACTORY—

● Corhart Electrocast Refractories are high-duty products which have proved considerably more effective than conventional refractories in certain severe services. If your processes contain spots where a better refractory is needed to provide a balanced unit and to reduce frequent repairs, Corhart Electrocast Refractories may possibly be the answer. The brief outline at the left gives some of the basic facts about our products. Further information will be gladly sent you on request.

Corhart Refractories Company, *Incorporated,* Sixteenth and Lee Streets, Louisville 10, Kentucky.

"Corhart" is a trade-mark, registered U. S. Patent Office.

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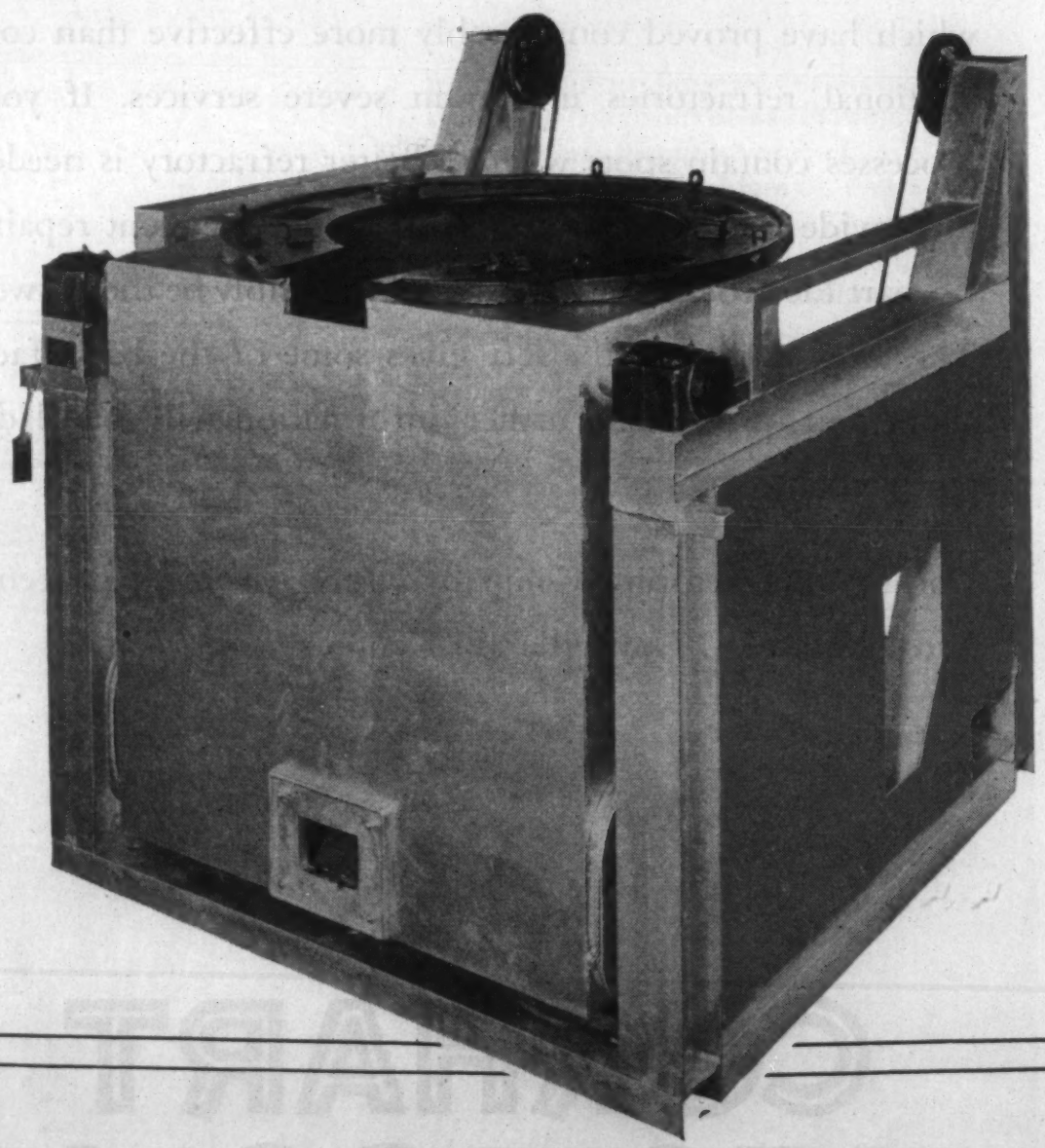

THE MONARCH ENGINEERING AND MANUFACTURING CO.

Curtis Bay Baltimore, Md.

(2) Sodium carbonate produces effective desulphurization in both calcined dolomite and stabilized dolomite even when the initial sulphur content is less than 0.03%. In acid linings, the treatment produced little desulphurization of these low-sulphur irons.

(3) An appreciable degree of desulphurization took place in all linings when the initial sulphur content was in the range of 0.10 to 0.20%.

(4) The basic linings are but slightly attacked in contrast to the siliceous linings, which are severely attacked.

—N. L. Evans. *Metallurgia*, Vol. 29, Nov. 1943, pp. 17-19.

Bronze Castings for Merlin Engine

Condensed from "Foundry Trade Journal"

The bronze castings on the Merlin engine range in weight from a few ounces to 20 lb., and are cast in phosphor bronze, B.S.S. 2B8; aluminum bronze, DTD. 174A, or silicon bronze (Everdur).

There are three methods of manufacture used in production: sand casting, gravity die casting, and centrifugal casting.

It is well known that the oxide film that forms on molten aluminum bronze is of a peculiar leathery texture and will, if allowed to enter the casting, form a distinct fissure in the casting. Consequently, the gating system is designed to give a uniform and balanced entry of the metal into the mold cavity with the minimum of turbulence.

In addition, a generously proportioned riser over the thicker section not only provides the necessary feed to ensure soundness, but serves as a safety measure to take care of the oxide film inevitably formed on the metal surface during its quiet displacement of the air from the mold cavity.

Castings made of Everdur are for atomizer covers and connections, having pipe brazed in after machining. These castings have been fairly successfully produced as sand castings, machine molded. As there is no machining on the outside, if there is the slightest crossover the casting must be scrapped.

To add to the difficulty, these castings must stand a 30 p.s.i. pressure test. It was therefore decided to make these castings by the gravity die-casting method. The dies are made of cast iron, and are brushed over with heavy oil. Using the gravity method, an excellent finish is obtained, and examination of fracture shows very dense and sound structure.

Microscopical examination of the phosphor bronze castings revealed that the copper, copper-phosphide eutectic is finely distributed throughout the alpha ground mass. The segregation of this eutectic in the sand-cast alloy is much coarser than that obtained from the chill cast alloy.

Examination of the fracture of die-cast silicon bronze shows a very dense close-grained structure. The airscrew collet is centrifugally cast in liner form.

—John Allan. *Foundry Trade J.*, Vol. 71, Dec. 2, 1943.

ALUMINUM, TOO, LIVES TO FIGHT AGAIN!

Many lives are being saved today by the transfusion of blood . . . from the workers on the home-front to the fighters on the battle-front. Our blood can now bring new life to the sick and wounded . . . can enable some boy out there to live to fight again another day. This is one of the wonders of medicine that is helping to shorten this war.

And one of the wonders of metallurgy is also helping to shorten this war. It is the re-enlisting of aluminum so that it, too, can live to fight another day. A bomber is shot down in flames . . . a tank is blown to bits . . . a gun emplacement is hit by enemy shells . . . and only a heap of twisted metal is left. Yet from that wreckage may now be forged new weapons that will hammer out new victories for the Allies.

We, the members of the Aluminum Research Institute, are producing these aluminum alloys . . . meeting the government's high standards of quality . . . so that aluminum can fight again till peace is won.

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Blackening Non-Ferrous Metals

Condensed from "Product Engineering"

There are four general classes of black finishes: Oxide, metal complexes, sulphide and telluride, and metallic. Characteristics of the first have been found superior for some applications.

Black oxide coatings have excellent adhesion, good corrosion protection, temperature stability and deep blackness, and are a good base for organic finishes. Thickness is usually from 0.00002 to 0.00005 in., but sometimes 0.0005 in. may be reached.

Black oxide coatings may be applied by direct chemical oxidation at low temperatures, direct oxidation at high temperatures, electrolytic oxidation, anodic deposition, chemical reduction from a higher valence state, and chemical precipitation.

The first, on copper and its alloys, recently reached wide commercial use, producing the most satisfactory finish. It utilizes aqueous solutions of strong oxidizing agents in the 120 to 250 F. range. Copper and alloys can be oxidized directly to cupric oxide, stable and exceptionally adherent.

This coating, when oiled, protects against salt spray up to 200 hr.; unoiled, for 20 hr. It is widely used on marine equipment.

Cupric oxide coatings stand deformation; they produce a nearly perfect optical black; they are suitable for heat-radiating apparatus; they are suitable for high-purity copper parts of electronic power tubes, and are a good base for paints, enamels and lacquers.

Any metal capable of being copper-plated can be cupric oxide finished by copper plating and oxidizing. It is better than black nickel plating because it is easier and has greater depth of color and adhesion. But the alloys must have at least 65% Cu.

An interesting method of blackening nickel requires the use of an oxidizing agent, such as hydrogen peroxide or ammonium persulphate, together with a substance that forms small amounts of sulphide ions in solution, such as ammonium thiocyanate. The bath is operated in a low pH range from 1 to 2.

Direct oxidation at high temperatures is one of the oldest methods for producing black oxide coatings. When copper is heated in air or oxygen to 800 F. and over, heavy coatings are formed — an outer coating of black cupric oxide and an inner one of red cuprous oxide.

Coating Aluminum and Zinc

Electrolytic oxidation of aluminum and zinc has grown more popular. Usually sulphuric acid solutions are used because heavy oxide coatings of 0.0001 to 0.003 in. are formed and can be dyed easily in any color.

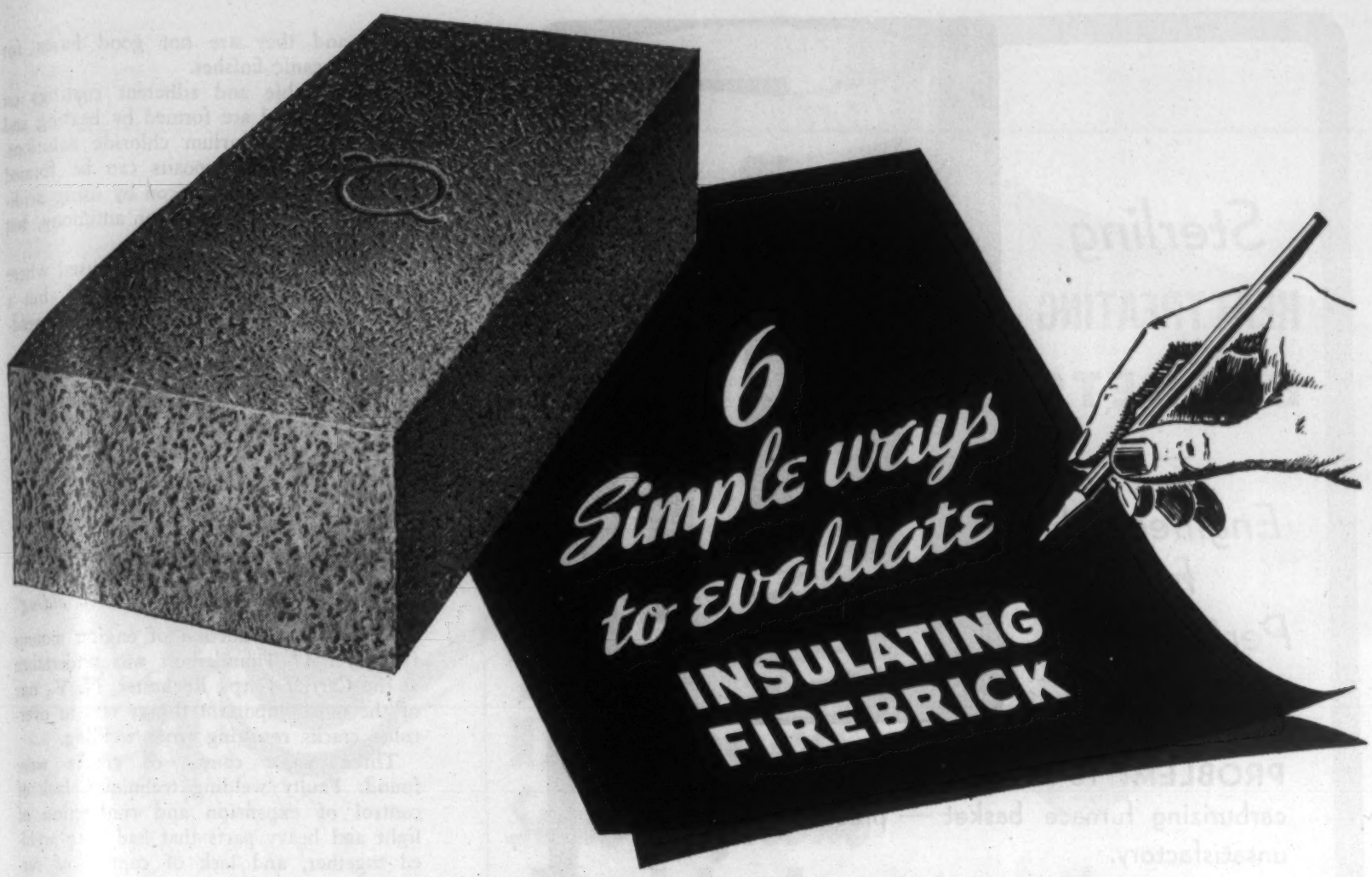
In Germany, an interesting method was used to involve the oxidation of aluminum: The oxide was impregnated with a silver emulsion and the surface was then sensitized, using it in the manner of photographic print paper. It may be important after the war.

Zinc-base die castings can be darkened by making them the anode in a dilute sodium hydroxide solution. Zinc and its alloys are blackened by molybdate solutions and by nickel-ammonium thiocyanate solutions.

Chemical reduction from the higher valence state is highly successful commercially in the case of molybdenum sesquioxide coatings for zinc and its alloys. Molybdenum is reduced from the hexavalent state to the sesquivalent state.

The copper carbonate-ammonia method is widely used on brass. The bath utilizes basic copper carbonate to which ammonia has been added to form a soluble blue complex, being effective where copper content of the brass is 65 to 80%. But corrosion protection is not good.

Black sulphide coatings are easy to apply. They are formed on copper and silver by immersion in dilute sulphide solutions, but they do not stand much deformation, they offer little corrosion protec-



Different grades and makes of Insulating Firebrick have widely differing properties. To obtain the maximum value for a given application, select the brick that will best fulfill the following:

1—*Limiting Service Temperature*—
The group or grade of insulating firebrick is established by the maximum temperature at which your furnace will operate. Select the group or grade next above this temperature.

2—*Weight and Conductivity*—
Generally, the lighter the brick, the lower the conductivity will be. Heat losses can be kept at the minimum only by selecting the lightest brick with the lowest conductivity. Compare conductivities based on ASTM test C-182-43T. Do not compare results obtained by different testing methods; they cannot be correlated.

3—*Stability*—
Cold crushing strength does not always indicate the stability of an insulating firebrick under fire. Compare the hot-load strengths. This is an essential factor for spring arch and for high wall construction and an important indication of length of service to be expected.

4—*Durability*—
Insulating firebrick should show little or no permanent volume change after heating to their recommended temperature limits. Compare results based on ASTM test C-93-42.

5—*Responsibility*—
Consider the manufacturer's responsibility, his ability to produce uniformly high quality materials, and his knowledge and experience with applications of insulating firebrick to different types of furnaces.

6—*Value*—
An evaluation of benefits and advantages for your particular furnace application should be made as a final step. Price alone is no criterion—a low price may result in an expensive investment.

Your local B&W representative will be glad to give you the necessary information on B&W Insulating Firebrick to make this kind of an evaluation.

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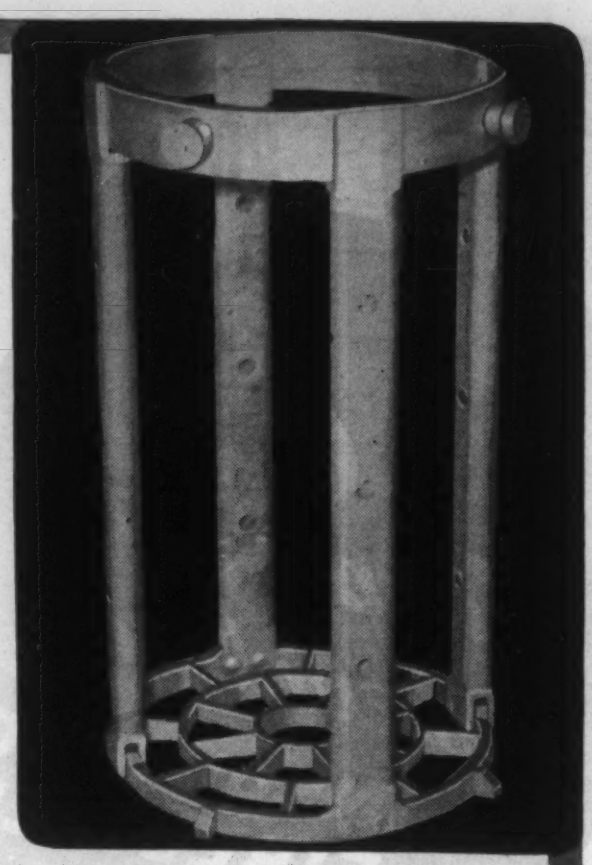

PROBLEM: To redesign a rigid welded type pit carburizing furnace basket — present service life unsatisfactory.

ANALYSIS: Early failures resulted from excessive stress concentrations both thermal and mechanical, common to rigidly fabricated structures at high temperatures coupled with vital weld failures due to carbon deposits in weld cracks.

SOLUTION: A new articulated design embodying all Sterling Four Factors minimizing thermal stresses with ample mechanical strength — "carbon explosions" virtually eliminated by absence of load carrying welds.

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tion, and they are not good bases for baked organic finishes.

More stable and adherent coatings on silver and gold are formed by heating and decomposing tellurium chloride solutions. Smut type black deposits can be formed on zinc, cadmium and iron by using acidified solutions of arsenic or antimony, but they adhere poorly.

Black chromium coatings are used where high temperatures are encountered, but a drawback is the high current density needed for the process.

—Walter R. Meyer. *Product Engrg.*, Vol. 14, Dec. 1943, pp. 792-794.

Aircraft Engine Weldments

Condensed from "Industry and Welding"

When the production of engine mounts for the P-47 Thunderbolt was undertaken at the Carrier Corp., Rochester, N. Y., one of the most important things was to overcome cracks resulting from welding.

Three major causes of cracks were found: Faulty welding technique, lack of control of expansion and contraction of light and heavy parts that had been welded together, and lack of control of surrounding atmosphere in the welding department.

Correction of technique was entirely a matter of instruction. Thus, on brackets and clips that had to be welded to leg assemblies and ring tubing, the welder should start his weld slightly in advance of the bracket and clip to be welded and weld for about ¼ or ½ in., being sure that the weld was built up and not drawn out with a resulting crater or vee, as it was at this point most of the cracks occurred. The finished weld was then started from the other end, and a complete weld made by finishing and overlapping the first weld.

Preheating with oxyacetylene torches to 300 F. provided good penetration, particularly when welding light tubing to heavy forgings. This controlled shrinkage, reduced straightening after welding, and eliminated cracks. One must not overheat lest defective welds and additional cracks result.

It was easy to control atmospheric surroundings of the welding area by air-conditioning. Equipment was installed to maintain a temperature of 70 F. at all times. Windows were kept shut to prevent drafts causing quick chilling of welded areas, and minor cracks. The department is on the top floor, where large skylights often make the temperature 100 F. without air-conditioning. Besides helping the process, the air-conditioning kept workers comfortable and efficient.

As a result of the program, the former average of 12 cracks per assembly dropped to two. Some welders have done eight to ten engine mounts successively without any signs of cracks. We have now turned out many mounts for the Thunderbolts, and have scrapped only one.

—William H. Irwin. *Industry & Welding*, Vol. 17, Jan. 1944, pp. 32-33, 59.

(Continued on page 934)

*Factual case in large mid-western appliance plant.

The Lindberg *Super-Cyclone* doubled output* *with all this saving in space!*

The principle of forcing hot air through the charge at high velocity gives many advantages to the Lindberg Super-Cyclone Furnace.

Take floor space: For normalizing grey iron castings, one plant loaded them into the basket of a single Super-Cyclone, then heated and dumped, doing the work in 8 hours which had required 8 box type furnaces and16 hours. *The Super-Cyclone did 12 times the work per square foot of floor space.*

The fan-driven air, pre-heated in an isolated chamber, builds up temperature with rapid uniformity *throughout the charge* to anywhere between 300° and 1750° F., with accurate control. There is no radiant heat to cause distortion.

This revolutionary heating principle keeps work straighter, saves time and space and production costs. Besides, the Super-Cyclone can be used either for normalizing or annealing, for hardening or for tempering.

Write for complete information about this money-saving, time-saving, space-saving furnace, to Lindberg Engineering Company, 2451 W. Hubbard St., Chicago 12.

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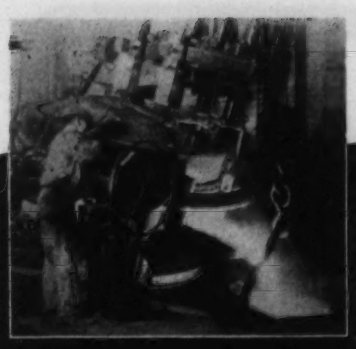
CYCLONE for accurate, low-cost tempering and nitriding
HYDRYZING for scale-free and decarb-free hardening



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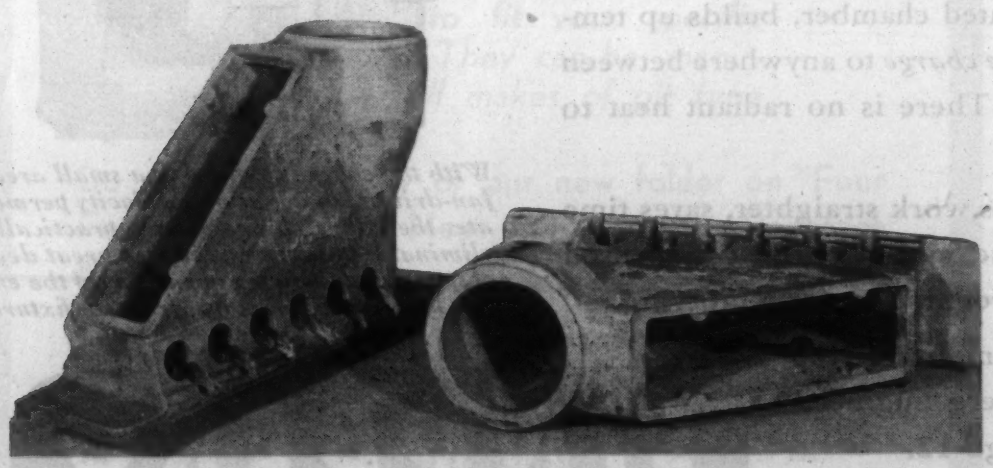
Let Duraloy take care of your next chrome-iron or chrome-nickel castings. They will be alloyed by Metallurgists who understand process plant requirements and poured by Foundrymen who know how to handle high alloy castings . . . an art in itself.



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4-DU-2

Making Bearings and Other Parts

Condensed from "Automotive and Aviation Industries"

Two main plants house the activities of the Cleveland Graphite Bronze Co. The first is devoted to the manufacture of large Diesel engine bearings and bushings along with a Ford department, while the second specializes in automotive type precision bearings and a complete line of aircraft bearings and bushings.

Great flexibility is required because the automotive plant processes some 1000 types of shells, which fall into the following general types: Sleeve-type copper-lead alloy bearings, sleeve-type copper-lead alloy bushings, sleeve-type silver bearings and bushings, and thrust- and special-type washers with copper-lead or silver faces.

The aircraft plant produces over 150 distinct types of bearings that include thin wall precision-type bearing shells produced from strip, coated with copper-lead or lead-base alloys, and Clevite bearings made from copper-lead coated strip.

The quality of the finished bearing is determined to a large extent in the foundry, and for this reason the foundry is considered the "heart of the aircraft bearing process."

In the manufacture of copper-lead alloy bearings, the shell is rough machined and thoroughly cleaned. Cores are fitted, and the assembly goes into a furnace for heating to the right temperature.

The copper-lead alloy is delivered in small ladles from the melting furnaces to induction heating furnaces for refining and heating to the proper temperature. The heated molds are filled near the induction furnace and immediately dropped into a water-quench to freeze the bearing lining on the shell.

On cooling, the castings are sent to the cleaning room for core knockout and sand blasting. All castings are X-rayed after rough machining before leaving the foundry.

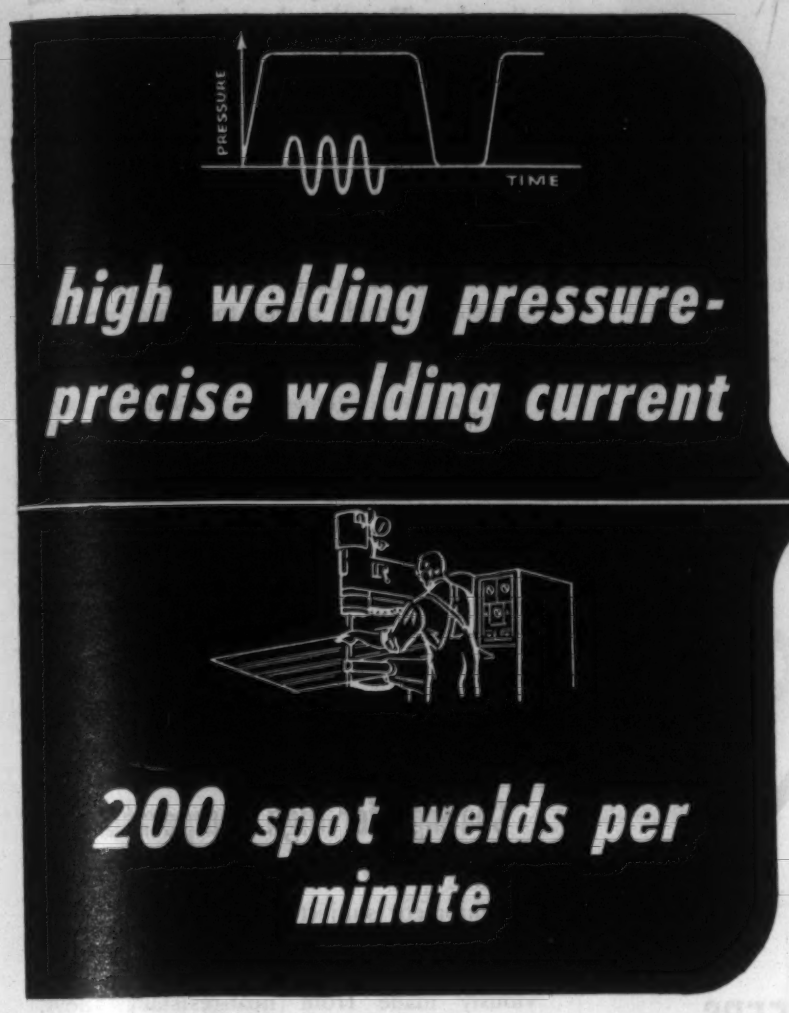
In making very large bearings, a weighed amount of alloy is placed in the rough machined shell, which has a disk welded tight on one end and a disk sealed on the other end after filling with the alloy shot. The sealed shells are placed in large rotary hearth furnaces to melt the shot and bring it to the proper temperature.

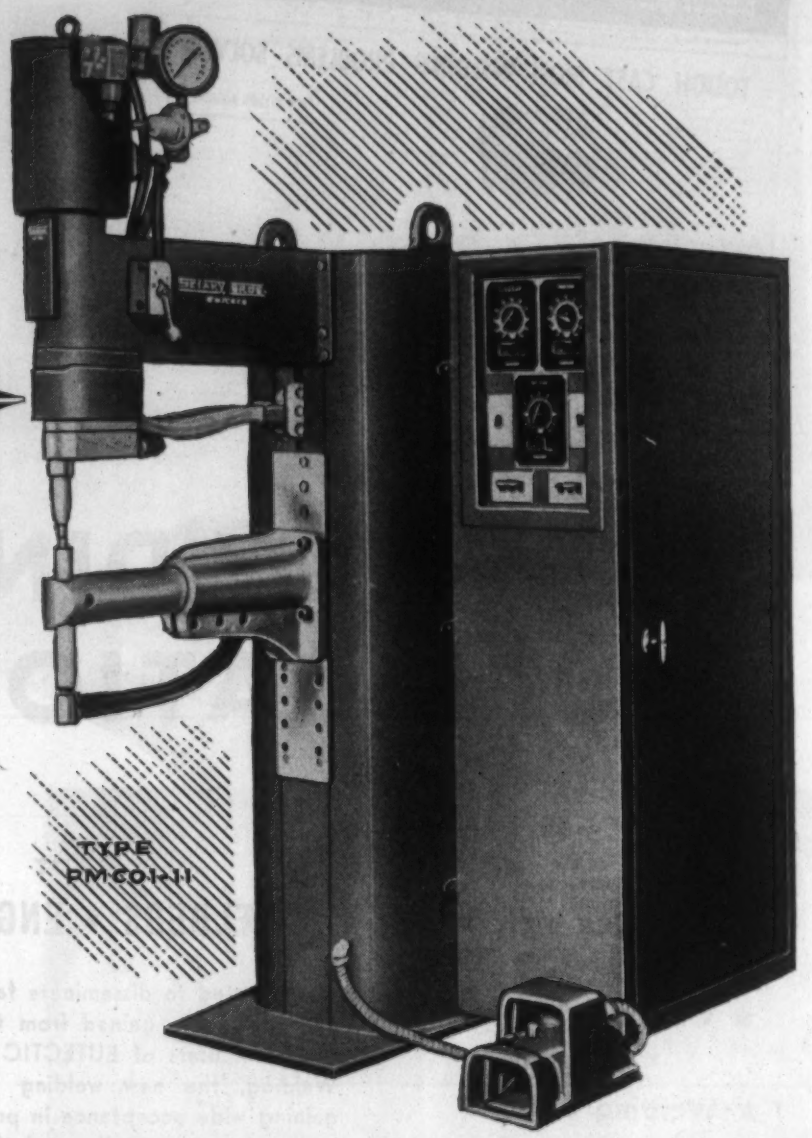
The shells are then removed from the furnace, chucked in a lathe and spun at a predetermined speed to distribute the metal by centrifugal force. Simultaneously, the shell is chilled by a nozzle spray of cold water to freeze the layer of bearing metal.

The strip mill is divided into two departments — one for copper-lead and the other for white metal. Coiled strip is sent through a long, automatically-operated mill that forms the channel, and is then sent to a furnace for heating to the proper temperature to receive the molten alloy.

After pouring, the strip goes through a cooling chute and some is annealed. All of the strip is given some preliminary machining in the mill before being sent to the machine shop.

The white metal department has four automatic lines. The coils are butt welded into continuous lengths, and the strip is





. . . mean high quality, high production welding on light gauge ferrous alloys.

This 60 KVA Sciaky Spot Welder is specifically designed for the high quality welding of stainless steels, mild and zinc-coated steels, monel metals, brass and copper. The high pressure (up to 2600 lbs. psi) and electronic current timing assure high shear values wherever structures are subject to stresses and vibration.

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SELF-CONTAINED UNIT . . . Electronic controls and ignitron contactor are mounted in a hinged cabinet convenient to operator . . . simplifies installation.

SCIAKY ELECTRONIC TIMER . . . The patented Sciaky Timer uses no intermediate relay, but operates a heavy duty relay direct from the tube.

TRANSFORMER . . . Secondaries are hard rolled copper — having less tendency to overheat than cast.

HEAD RETRACTION . . . Retraction of 2¼" is controlled by foot switch. Short working stroke (½") eliminates tendency of electrodes to hammer.

SCIAKY ELECTRO VALVE . . . Air to the operating cylinder is controlled by a specially designed, fast-acting d.c. operated solenoid valve.

FLEXIBLE BRAIDED CABLES . . . These are used between the transformer and upper electrode and result in less tendency for fatigue breaks.

FOOT SWITCH . . . Stroke on hooded foot switch is ¼"—operator need not raise entire foot from floor.

AUTOMATIC WATER SHUT-OFF . . . Water supply to electrodes is cut off when head is retracted or control switch off—means quicker electrode change.

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anodically cleaned, chemically etched and tinned. The tinned strip is then lined with babbitt and, on cooling, is rough machined and sent to the annealing furnaces.

The machine shop is modern, and one of its features is the installation of bus duct for power distribution. Flexibility of the shop operations has been facilitated by keeping the number of makes and types of production equipment at a minimum. Cemented carbide tipped tools are used for metal cutting, and centerless grinders for OD grinding.

—J. Geschelin. *Automotive & Aviation Inds.*, Vol. 90, Jan. 1, 1944, pp. 20-24, 81-82, 84.

Coatings for High Temperatures

Condensed from "Products Finishing"

Equipment subject to high temperatures, such as melting pots, retorts, and annealing and carburizing boxes, which were previously made from heat-resistant alloys, must now be made of materials less resistant to high temperature oxidation.

Ordinary hot-rolled steel may be protected against high-temperature oxidation by sprayed metal coatings. Before applying the sprayed coatings, the surface is cleaned and roughened by blasting with angular steel grit. Three processes are described.

In the first, aluminum is sprayed onto the surface and the sprayed surface is then painted with a special sealer. A heat treatment is then given the article, which causes the aluminum to alloy with the base metal. The resultant surface gives protection up to 1700 F.

In a second process, the sprayed coating is a nickel-chromium alloy. Aluminum is also applied in a sealing agent. No heat-treatment is necessary. The coating is used at temperatures up to 1900 F., in application where sulfurous gases are not present.

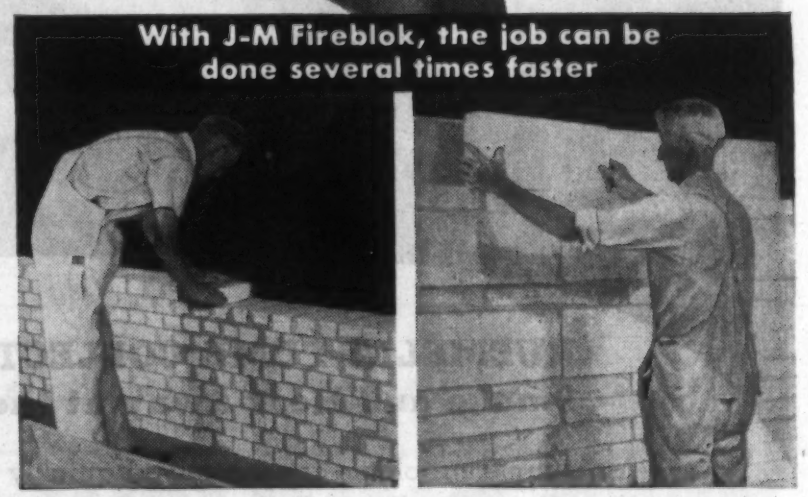
The third process is similar to the above, but a 50% heavier coating of nickel-chromium alloy is used. The coating may be used for all temperatures, whether or not sulfurous gases are present. No special heat treatment is necessary, since alloying of the coating with the base metal takes place in service.

Examples are described of successful applications of these processes to wire annealing retorts, melting pots for magnesium, and carburizing boxes. The life of carburizing boxes was increased 700 to 900%, and the properly treated magnesium melting pots appear to have an indefinite life.

The coatings are easy to apply and may be readily used on fabricated articles, thus assuring complete coatings over welds, bolts and nuts. The two latter processes can be used only under license.

—H. S. Pickard. *Products Finishing*, Vol. 8, Dec. 1943, pp. 56-62.

NEW TIME-SAVING
REFRACTORY LINING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to make possible faster, more efficient installations

THESE FOUR new light-weight J-M Insulating Refractory Linings are suitable for the same service conditions and range of temperatures as the four well-known J-M Insulating Fire Brick. The only difference is in size . . . a single Fireblok covers more surface than five full-size brick.

The large, convenient size of Fireblok provides many advantages. The greatest, perhaps, is the reduction in installation time, minimizing down time and consequent loss of production. On most jobs Fireblok linings can be installed in considerably less time than is required for standard size brick. The many hours thus saved help to keep production schedules at their peak. Fireblok has these important features, too:

Easy cutting and fitting—J-M Fireblok can be easily cut with a saw and shaped with a rasp. Most special shapes can be either shop or field cut from standard slabs, reducing the inventory of special shapes.

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Economical Bonding—with reduced joint length Fireblok requires a minimum of air-set cement for bonding. (J-M 1626 Cement was especially developed for this use.)

Uses—Fireblok can be used wherever Insulating Fire Brick are recommended such as for heat-treating furnaces, flues, stacks, mains and similar equipment. Also for the lining of doors, suspended arches, and, when tapered, for sprung arches of exceptional stability.

Write for new booklet, IN-103A, on this J-M development. Johns-Manville, 22 East 40th Street, New York 16, New York.

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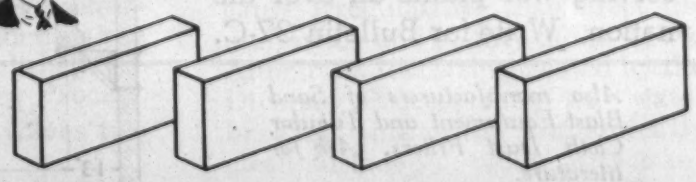

JM-1620 Fireblok for exposed temp. to 1600° F. As back-up to 2000° F.	JM-20 Fireblok for use up to 2000° F. Exposed or back-up	JM-23 Fireblok for use up to 2300° F. Exposed or back-up	JM-26 Fireblok for use up to 2600° F. Exposed or back-up

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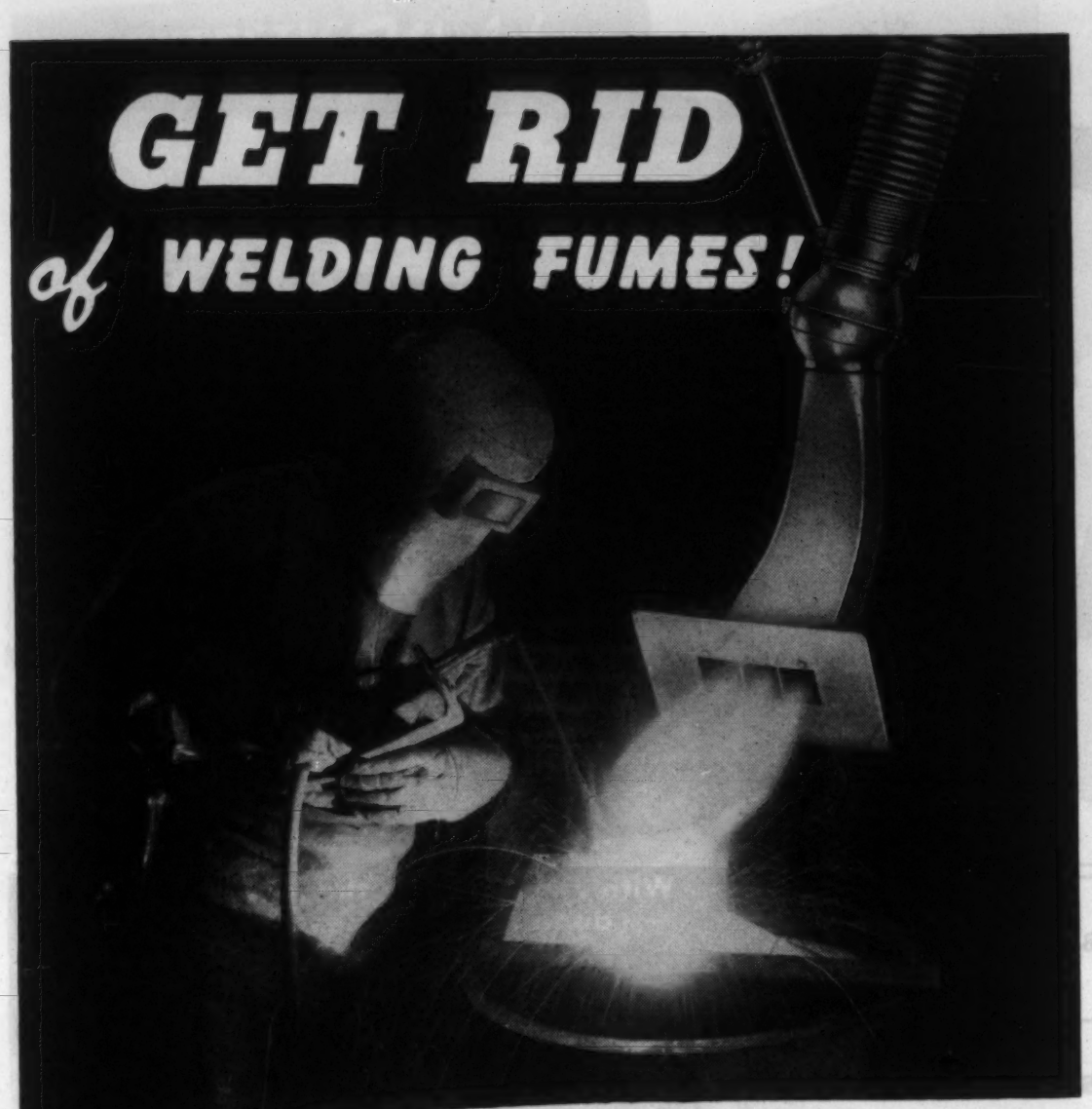

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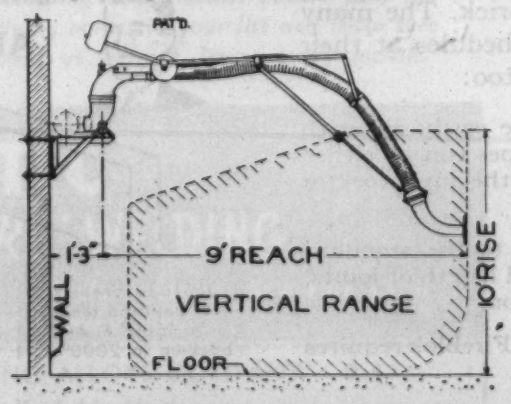

Arm extended for maximum reach. Note unusually wide working range.

RUEMELIN
WELDING FUME COLLECTORS

Influence of Quenching Temperature

Condensed from "Stahl und Eisen"

In case hardening, the difficulty is often encountered that the core does not always possess the desired toughness and strength when the casing has the required hardness, even in double-hardening, *i.e.* first core-hardening and then final case-hardening; the core is sometimes grainy instead of tough due to ferrite precipitation.

Experiments are described made to find eventually a single heat treatment to replace the double-hardening with satisfactory results. It was found that in order to obtain glass hardness of the case layer and required strength of the core, the cooling from 880 or 820 C. (1615 or 1510 F.) down to the temperature of the A_1 point should be slow; this holds good for both hypopearlitic and hyperpearlitic steels. After this point, rapid cooling can be applied.

While this treatment in hyperpearlitic steels does not produce increased carbide precipitation, hypopearlitic steels showed ferrite precipitation at the grain boundaries that has no effect on full hardening and the mechanical hardening properties.

The ferrite precipitation could be suppressed by an addition of vanadium or other strong carbide former, or could be delayed by an addition of aluminum.

If the Ar_3 point instead of the A_1 point was selected as the lowest temperature for the delayed cooling, the ferrite precipitation could also be prevented by the addition of vanadium or aluminum.

—R. Schäfer & W. Drechsler. *Stahl u. Eisen*, Vol. 62, June 11, 1942, pp. 497-503.

Knurling on the Screw Machine

Condensed from "American Machinist"

Knurling is one of the most interesting and versatile operations performed on a Brown and Sharpe automatic screw machine. Several important points in good knurl tool usage are: (1) Feed a knurl into the work only a distance equal to the depth of the tooth on the knurl; (2) the coarser the pitch on the tool, the greater the displacement of metal and the larger the knurled diameter; (3) steady even knurl feed is necessary; and (4) blunt 90° knurls are superior on soft metals, while 70° knurls should be used on steel.

There are four principal methods of application that require the following types of toolholders: side knurl holder, adjustable turret knurl holder, top and bottom knurl holder for cross-slides, and turret swing tool knurl holder.

The first type is the most common and easy method of knurling, but requires an open cross-slide circular toolpost. Since the side pressure is high, light feeds should be used.

The adjustable turret knurl holder is the most adaptable and versatile, for straight, diamond or spiral knurled diameters may be produced with a pair of straight knurls. This type of holder can be fed at a rate seven times greater than in cross-slide

930 SPOTS

BEFORE TIP FOULING!

DIVERSEY PROCESS FOR PREPARING ALUMINUM EXCELS IN COMPARATIVE

SPOT WELDING TEST

HELP WANTED!

Here's one "help wanted" problem that's easily solved . . . even in these days of man-power shortages. If it's a problem in metal cleaning and working . . . the Diversey D-Man is always on deck to lend a helping hand. Backed by a Research Laboratory that has spent 18 years developing special purpose products, the Diversey D-Man can often show you ways to step-up production that require less man-power.

DIVERSEY D-MAN

In a recent independent production test with 13 other processes, aluminum treated by the Diversey Process averaged 930 spots before tip fouling. All shear test requirements were easily met. Results . . . checked and rechecked by technicians in the plant conducting the test . . . definitely established the excellence of the Diversey Process.

The Diversey Process involves two simple steps:

1. Removing all foreign matter from the surface with Diversey Aluminum Cleaner, a dry, white powder, easily used in still tank cleaning, whose powerful cleaning action is inhibited to prevent pitting, staining or discolorations.
2. Eliminating the oxide film with Diversey DC No. 1, a non-toxic, non-fuming powder developed to replace harsh, corrosive, dangerous acids.

It has been definitely established that the production of consistently sound spot welds is, in part, a function of the surface treatment. The presence of oxide film and its attendant high electrical resistance cause irregularities that affect the uniformity and quality of the welds. Aluminum test strips treated by the Diversey Process show no "water breaks," indicating a chemically clean surface . . . while surface resistance averages as low as 12 microhms.

Today the Diversey Process is in use in many large aircraft and other plants throughout the country . . . consistently giving quality spot welds with greatly increased tip life. For further details send for free technical bulletin No. 501. Address Metal Industries Dept. W4,

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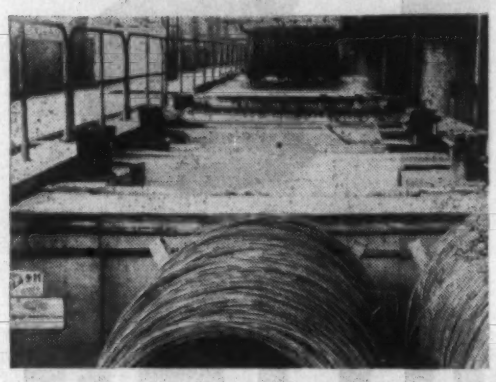

Seven years ago—a sketch. Today 58 units based on this idea are baking rod in as fast as six minutes instead of hours —saving millions of hours and speeding production of rod products. Perhaps we can help you speed up a baking operation.

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Morrison engineered and built the first continuous equipment for the manufacture of shielded arc welding rod, cutting costs and increasing production. Perhaps Morrison experience can be combined with some idea you have to bring about the same results on your product.

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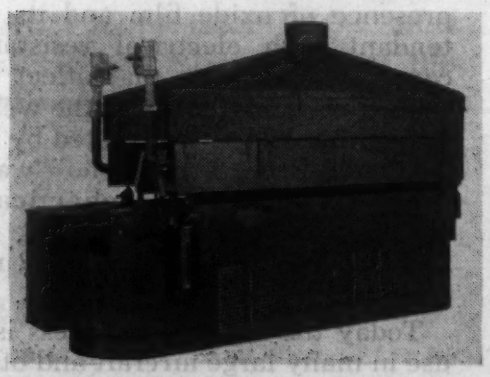

As soon as the shortage of brass forced the use of steel for cartridge cases, Morrison was ready with the first practical continuous flame-type unit for mouth and taper annealing. The same principle can be applied to the heating or annealing of dozens of post-war items.

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knurling, and can be used when both cross-slide tool holders are required for other tools.

In principle the third method, the use of top and bottom knurl holders for cross-slides, is similar to the first. This method is applied when all turret positions are taken by other necessary tools, or where no other turret tools would be required, providing the part can be top and bottom knurled.

The disadvantages are that it can be applied only when the required knurled width does not exceed that of standard knurls, and that it cannot be used where the required knurl is close to either form or cut-off tool.

The fourth method, using a turret swing tool knurl holder, requires somewhat complicated camming. Feeds are slower than when the adjustable turret knurl holder is used. Likewise, provision must be made for the approach of the knurl before the cross-slide may feed it into the work, and extra clearances must be provided at the completion of knurling to assure the cross-slide clearing away before the swing knurl may be indexed out of position.

Each type of knurling has certain practical and profitable uses; however, knurling needs must be carefully considered before cams are designed.

—A. Ainsworth, *Am. Mach.*, Vol. 88, Feb. 3, 1944, pp. 88-90.

Spot Welding Magnesium Alloys

Condensed from "The Welding Journal"

The coating to protect magnesium products may be either oil or chrome-pickle. The former is recommended for spot welding applications, as the necessary complete removal of the chrome pickle is difficult. Oil-coated material should be cleaned in a solvent and polished to remove the oxide film.

After spot welding, the entire assembly is chrome-pickled and thoroughly rinsed in water before painting. For greater corrosion resistance, parts may be boiled for 30 min. in a 10% solution of sodium dichromate.

Essentials for spot welding magnesium are reasonably high welding current capacity, positive control of pressure, and accurate control of welding time. Machine settings are substantially the same as for aluminum. Adjustment of the machine to the proper setting is important.

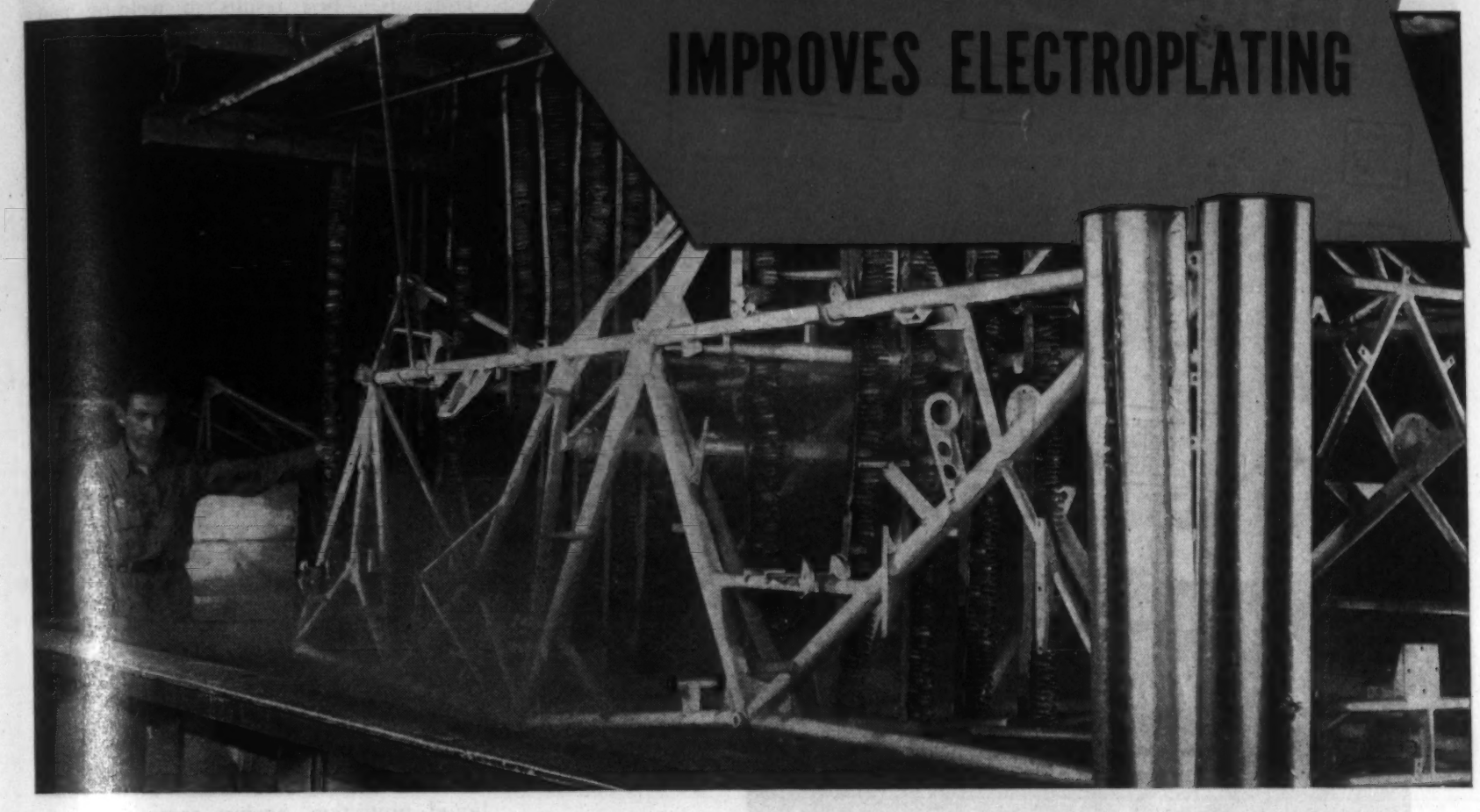
Electrode pressures that give high strengths and freedom from porosity and cracks should be used. With a short welding time, higher pressures are necessary to prevent flashing. Air-operated, low inertia, anti-fraction type welding heads are essential for quick follow-up. The electrodes must be water-cooled.

Rigidity of both arms during welding is necessary to minimize deflection of the tips. On hard-rolled Mg-6Al-1Zn sheet from 100 to 150 welds may be made without tip cleaning. On Mg-1.5 Mn alloy, the electrode must be cleaned every 10 or 20 spots. Tip temperature should be as

Prosolv *B*

offers outstanding advantages

NEW TURCO CLEANER IMPROVES ELECTROPLATING



Equally effective in still tank and electro-cleaning

So positive are the advantages of Turco Prosolv *B* that prominent electroplaters have switched to this new cleaner immediately following tests *although they had considered satisfactory the materials they had been using.*

Turco Prosolv *B* insures the chemical and physical cleanliness that is essential to 100% bonding to steel of zinc, cadmium, chromium and other plate. It removes every trace of oil, grease, smut, paint and rust preventive compound. It contains no soap; leaves no deposit. Rinsing is complete, even though parts may have dried.

A highly concentrated product, Turco Prosolv *B* is 100% active. Every particle works; there is no waste.

As this new cleaner is effective in both still tank and electro cleaning, it simplifies stocking and plant procedure where both processes are employed.

Try Turco Prosolv *B* for stripping tin deposits formed during certain electro-pickling processes. A standard cleaning tank may be used for this.

Call the Turco Field Service Man for details on this specially formulated electro and still tank cleaning material which is doing such a notable job the nation over. Write today.

Follow Prosolv *B* with Turco Descaler This second step in preparing steel for plating is as necessary to a perfect job as the primary cleaning operation in Prosolv *B*. Any rust, mill, welding or heat-treat scale will prevent bonding of plate. Turco Descaler removes these without attacking the base metal. Thus the combination of Turco Prosolv *B* and Descaler insures quality plating at low cost. Let us furnish full details.

Rust Bar treatment for unplated portions. Partially plated parts, if treated with Turco Rust Bar, are well protected from corrosion during indoor storage although subjected to severe conditions. A thin film of Rust Bar is resistant not only to airborne water vapor, but also to corrosive gases and other types of corrosive agents.

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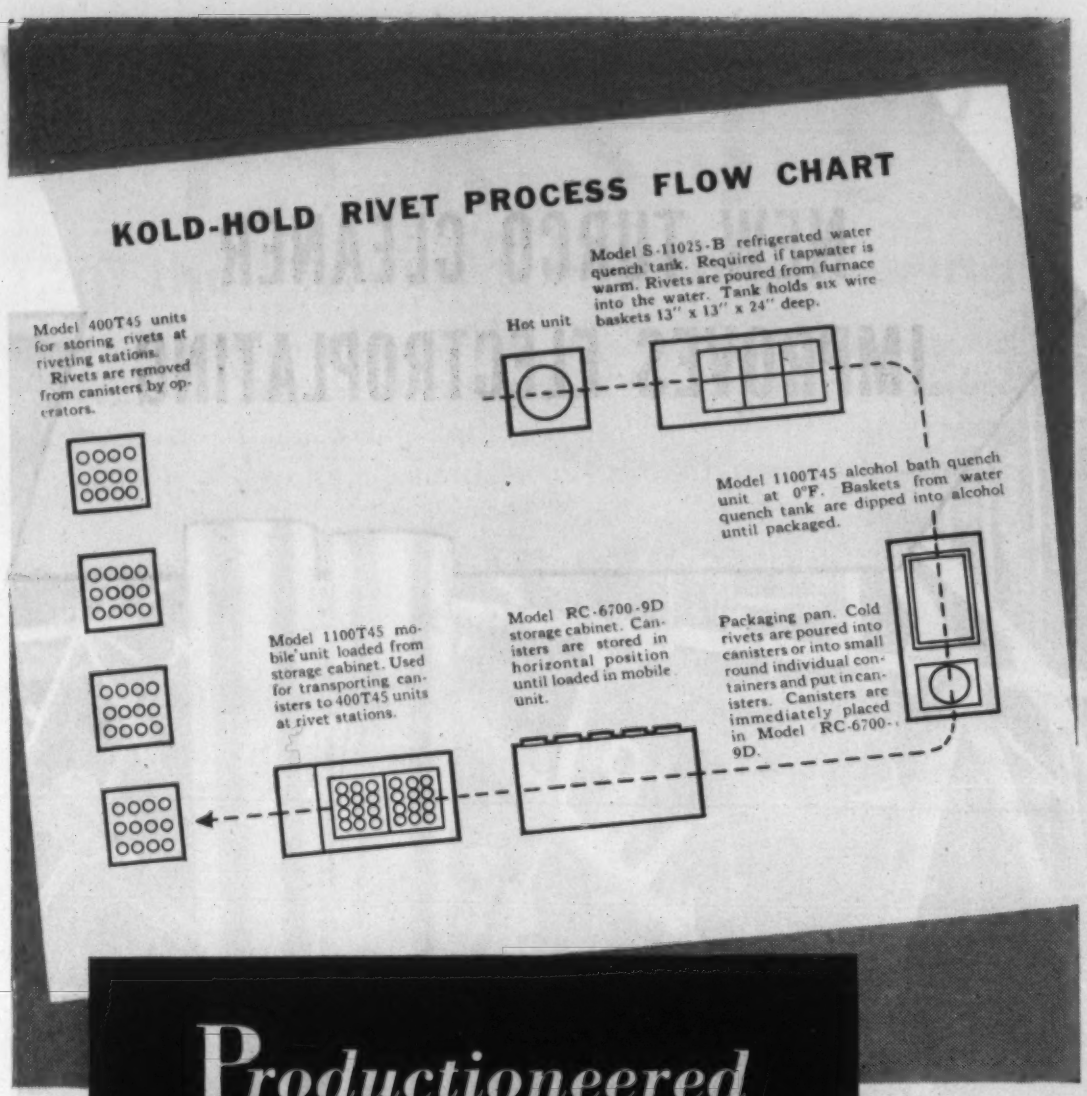

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The illustrated rivet process flow chart is a typical demonstration of Productioneering* by Kold-Hold . . . assuring capacity and temperatures best suited to specific cold processing applications and production schedules.

From quench tank to rivet storage machines on the assembly lines, the processing and storing of aluminum rivets is efficiently, quickly and dependably conducted with Kold-Hold Sub-Zero equipment. Each unit is designed to do a specific job, thereby cutting inspection rejects from 10 to 50%. Convenient tube assembly classifies rivets readily, . . . storage units — master and portable — located exactly where they are needed, assures smooth flow of production. . . . Rivets never leave container from quench to final assembly and consequently are always in satisfactory driving condition.

Write for catalog S-Z 431 for full data on this accepted Kold-Hold rivet processing flow system. Kold-Hold engineers will gladly assist in developing a flow chart to fit your specific application.

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low as is possible without condensation of moisture.

Control of current is usually varied on a.c. machines by an auto-transformer. A phase-shift device on the supply line keeps the line voltage constant.

In spot welding with electrostatic stored energy equipment, machines should have condenser capacities from 200 to 400 microfarads. Best results in welding magnesium have been obtained with the higher turns ratio and a somewhat longer welding time. Electromagnetic stored energy machines employ lower pressures, but are equipped with rapid pressure follow-up.

In welding alloys with dissimilar physical properties, solidification ranges, thermal conductivities and electrical conductivities must be considered. Weld strengths are assumed as the shear strength that will load the surrounding sheet as much as possible. Penetration should be not less than 30% nor more than 80% into each part.

To eliminate tip indentation, a flat tip may be used. When welding sheets of unequal thickness, the electrode with the larger contact area must be used against the thicker. For consistent spot weld strength, the cleanliness of the sheet, machine variables, tip deflection and proper electrode coating must be controlled. Tests show a beneficial effect of annealing after spot welding.

Spot-welded specimens with a chrome-pickle coating, exposed to atmosphere and tested in salt spray, show no preferential attack in the weld zone as do those not chrome-pickled. Spot-welded joints have been successfully fabricated using semi-liquid protection, against corrosion.

The design of joints must be such that the parts can be placed in the welding machine.

—W. S. Loose. *Welding J.*, Vol. 22, Dec. 1943, pp. 633s-640s.

Annealing Cold-Rolled Strip

Condensed from "Mitt. Kaiser-Wilhelm Inst. Eisenforsch. Düsseldorf"

Experiments were made with strip steel with 0.6 to 1% C in an electrically heated continuous furnace at 650 and 700 C. (1200 and 1290 F.) to find the effect of soaking time on annealing temperature, and also whether a small difference found in mechanical strength between specimens annealed in the batch furnace and in a continuous furnace could be eliminated.

No reduction in strength was observed in the cold-rolled strip, especially in the 10% cold-rolled sheets, at 650, but at 700 C. the same mechanical properties were obtained as in the batch furnace.

Both after batch and continuous annealing a distinct dependence of the mechanical properties could be observed on the degree of the previous cold-deformation, which was particularly strong in the 20% cold-rolled sheets that had low tensile strength and elastic limit.

Operators "CATCH-ON" Quicker

SIMPLER TO OPERATE

These outstanding advantages mean simpler operation to speed production, reduce training time and assure better welding results to aid the war effort.

SINGLE HEAT CONTROL—An infinite number of current settings with but one simple adjustment. An operator can't be confused. Machine provides automatic arc response on all classes of work—with all classes of electrodes.

"VISI-MATIC" CALIBRATION—Enables operators to select exactly the right current across the arc for each of the three classes of electrodes—high, medium, or low voltage.

WSR (Welding Service Range) RATINGS—Shows the exact limits of usable welding current the machine will deliver, from minimum to maximum capacities. There is no guesswork. You *know* what you can do.

CUT YOUR WELDING COSTS

With these vital advantages, operators spend more time actually welding, reducing time and costs. Moreover, square frame design permits stacking of machines and instant parallel hook-up. You can use two separate services or the combined amperage of two, or even three, machines in one service. It gives you greater welding flexibility, greater convenience and lower costs.

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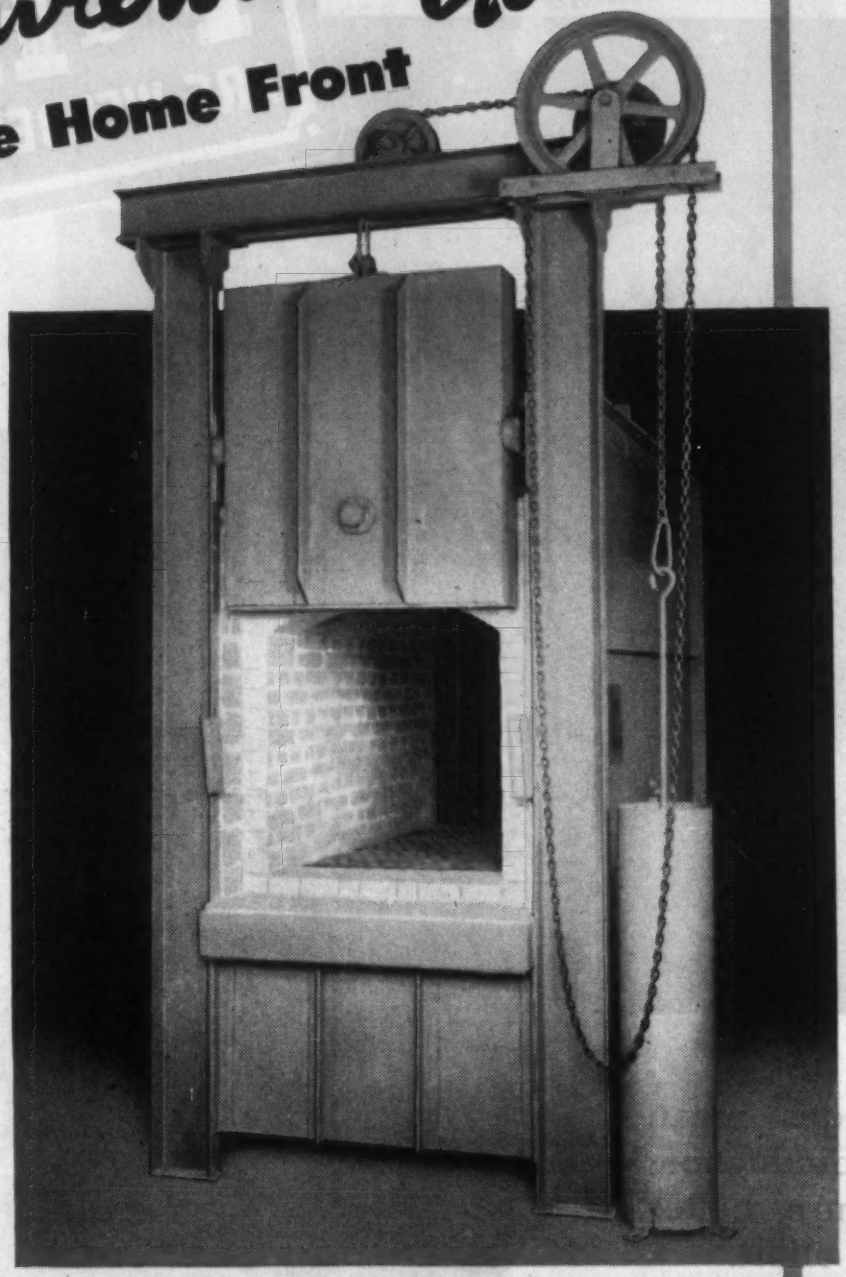
Whirlwind Action on the Home Front



Chamber
30 inches wide
30 inches high
54 inches deep

"Whirlwind" because of the circulation of a large volume of high velocity air, this R-S Electric Box Type Furnace is especially noteworthy because of its rugged construction and typical R-S efficiency. Constructed in various sizes for the heat treatment of aluminum and magnesium alloy stampings or castings. Prompt delivery.

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ANNEALING CONVECTION ROTARY HEARTH SALT BATH FORGING
CONTINUOUS CONVEYOR PLATE AND ANGLE HEATING METAL MELTING CAR HEARTH

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The influence of the different working conditions could mainly be found in a fairly gradual decrease of elastic limit with increasing soaking time at annealing temperature while tensile strength- and elongation at fracture remained practically the same. The 10% cold-rolled sheets showed a greater influence than the ones rolled with more than 10% reduction.

The changes also increased with increasing carbon content. Delayed cooling gave about the same values of mechanical strength as the longest soaking time, but had no particular advantage.

To obtain an especially soft strip, it should be rolled with reduction of about 10 to 20%. Annealing in both batch and continuous furnace is equivalent for sheets cold-rolled from 10 to 40%. The most favorable results are obtained at 700 C. with longest possible soaking time.

—A. Pomp & G. Neibch. *Mitt Kaiser-Wilhelm Inst. Eisenforsch, Düsseldorf*, Vol. 24, No. 16, 1942, pp. 235-241.

Pressure Forming of Metals

Condensed from "Western Metals"

This is a method of forming metal by the application of pressure to bar stock at elevated temperatures in order to cause the metal to flow and fill a die.

The temperature of the metal, as well as the temperature of the die, must be controlled within narrow limits that vary with the metal. Excessive speeds of forming the parts may cause grain growth, poor structure, poor grain flow conditions or cleavage. The required pressures are a function of the area, the alloy, the temperature, sequence of forming, and lubrication.

Lubrication is most critical, as improper lubrication can cause excessive corrosion, rough surfaces, improper contours, surface laps and inclusions. Although there is no ideal lubricant at the present time, it should have no sulphur, as little carbon as possible, and be capable of withstanding high temperatures.

The sequence of forming is generally governed by the part, as the direction of flow should be such as to produce the strongest possible product. Prior heat treating is practically the same as that used in standard practice for the alloy in question.

If this process is properly controlled, exceptional results are obtained. For example, the tensile strength of 24ST parts may be held consistently between 65,000 and 70,000 p.s.i. with transverse tensile strengths as much as 20% higher than the original extruded bar stock. The yield point is also increased, although the elongation may drop as much as 10%. Close tolerances may be held (0.002 in. for 1 in. diam.), and the part may be cored within limits.

Special hydraulic presses are used with die heating facilities and die opening and closing mechanisms. In the design of the dies, care must be taken to prevent the trapping of lubricant within the die.

ANNOUNCING A NEW CONVENIENCE TO FIRTHITE USERS

Through new arrangements with hundreds of "authorized" Tool Makers located in every industrial center in the United States, they are now prepared to supply Firthite-tipped tools for quick delivery. We suggest that you contact your **REGULAR TOOL MAKERS** for Firthite Sintered Carbide. In case you do not immediately find the Firthite tool maker or distributor nearest you, any Firth-Sterling Office will gladly give you the name of "authorized" Tool Makers who will now supplement our own facilities.

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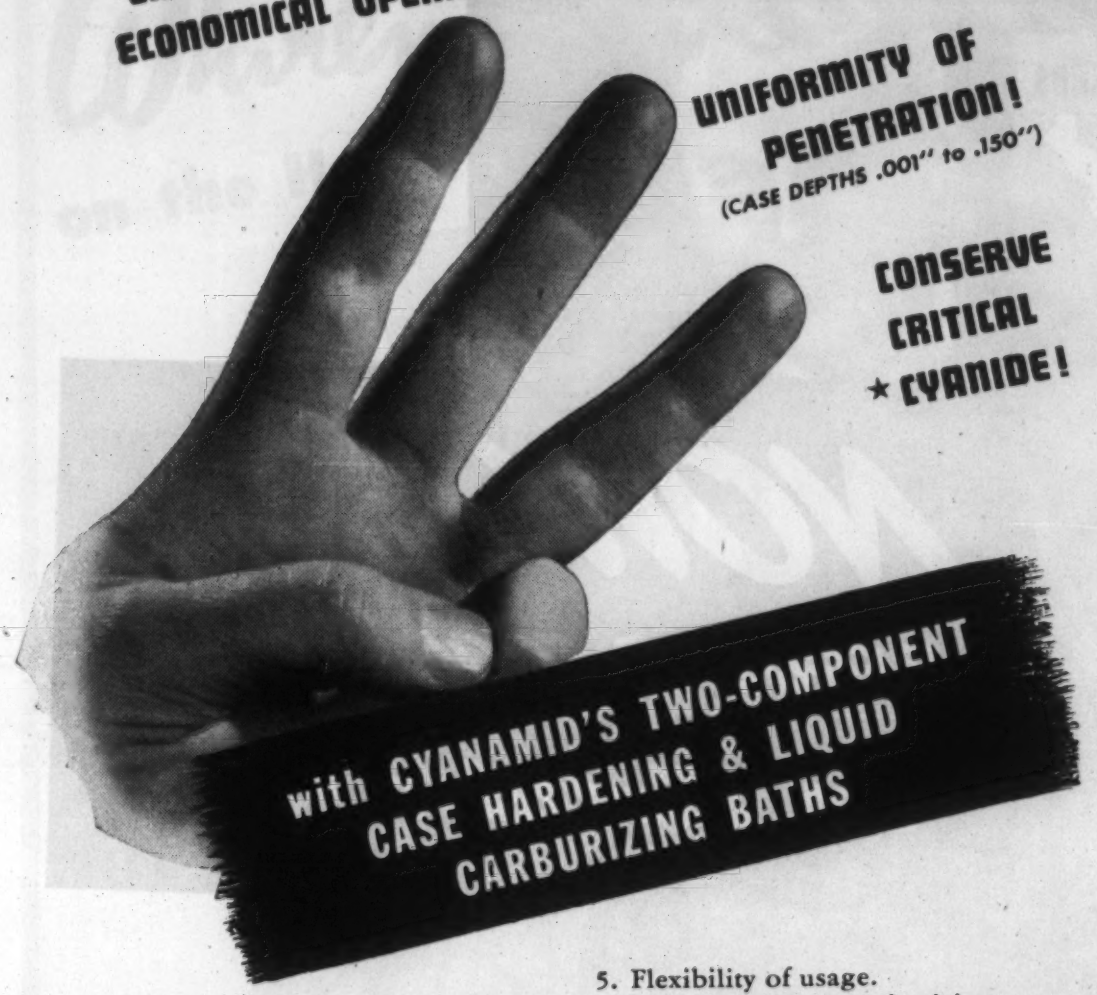

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1. Usable temperature range of 1300° F.–1650° F.
2. Non-hygroscopic and non-corrosive.
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1. Operating temperature of 1700° F.–1750° F.
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3. Maximum rate of case penetration.
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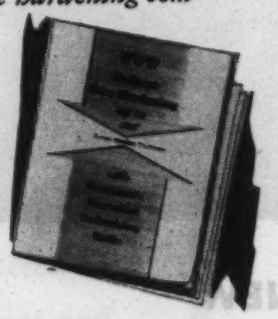
5. Flexibility of usage.
   (a) Maximum carburizing.
   (b) "Neutral" type hardening with same materials.
6. Ease of control.

★ Note: *Lower cyanide content required in Cyanamid activated carburizing baths as compared with the amount required in the non-activated types of cyanide case hardening compounds.*

An Important *New Reference* Text for the Metal Working Industry



A request on your company letterhead will bring you a copy of this new 32-page technical booklet containing the latest information on case hardening and liquid carburizing.

The facilities of our laboratories and the experience of our technical staff are available to assist in the solution of metal treating problems to which salt baths are applicable. We welcome an opportunity to discuss with you these problems.

*Reg. U. S. Pat. Off.

AMERICAN CYANAMID
& CHEMICAL CORPORATION
(A Unit of American Cyanamid Company)
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Future possibilities for this method are extremely interesting. Although the parts in production are 17S and 24S, experiments have shown that 2S, 3S, 11S and 14S aluminum alloys as well as magnesium may be formed equally as well.

—C. L. Davidson & W. E. Bloom.
Western Metals, Vol. 2, Jan. 1944, pp. 7-8.

Electrotinning at Weirton

Condensed from "Metal Finishing"

Electrotinning installations represent an investment of 50 to 60 million dollars throughout the country. One of the largest of these installations is at the Weirton Steel Co., Weirton, W. Va.

The plating unit consists of 24 identical cells, trough-like in form, 5½ ft. in length along the direction of strip travel, 4 ft. wide, and 8 in. deep. The tin bath is operated at a pH of about 2.7 and an optimum temperature of 150 F.

The anodes, which rest horizontally on the floor of each cell, can be replaced without stopping the line. The direct current equipment is capable of supplying 120,000 amp. The cell voltage usually ranges from two to five.

The thickness of the coating can be varied by adjusting the line speed and the current density. A thickness as low as ¼ lb. per base box can be deposited. Ordinary hot-dipped tin plate has 1.5 lb. of tin per base box. (A base box is 217.7 sq. ft. of metal, or 435.4 sq. ft. of surface.) To plate ½ lb. per base box, a current density of 216 amp. per sq. ft. is used, with a line speed of 1000 ft. per min.

The strip is fed from an uncoiler at the start of the line. Two uncoilers are provided, one being loaded while the other is operating. The new coil is welded to the end of the strip from the previous coil without stopping the line. A "pay-off" loop in the line ahead of the welder makes this possible.

The strip passes through an alkaline cleaner, a pickling bath, and then into the plating cells. The cells are laid out in a three-deck arrangement. On the ground level the strip passes through 12 cells in one direction. It then rises vertically to the second level and travels in the opposite direction.

On this pass the plating of the side of the strip that was initially upward is carried out. At the end of the second pass the strip again rises vertically to the third deck, where it resumes travel in the original direction. Here it goes through an alkaline and a pure water rinse, and then through a scrubbing process.

From here it passes through a drier, a second "pay-off" pit, and a high frequency induction heater. In the latter the tin is heated to the fusion point to flow the tin and give a bright surface. The strip then passes through a quenching bath, a drier, and finally goes to one of two alternate coilers.

Cans coated with the thin electrolytic tin plate are not suitable for the more corrosive types of processed foods, but

A TRIBUTE TO THE BATH IRON WORKS

from the makers of **PENNSALT CLEANERS**

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• The first ship built in America, the "Virginia," was launched from the shores of the Kennebec in 1607. The Bath Iron Works Corporation is carrying on the tradition of the Kennebec today, launching destroyers like the one above. At its present rate of production, B.I.W. produces in one year more than twice as many of these ships as were launched by them during the entire World War I. Our hats are off to the men and women who have made possible this enviable record.

How fine these ships are is well expressed in the following extract from a letter written by the commanding officer of the destroyer pictured above:

"A word of praise for the grand job the Bath Iron Works did on the ship. She has been through h—l and high water and never failed us. Keep on building ships as fine as this . . . We have put on nearly one hundred and fifty thousand miles and she is as good as new."

We of Penn Salt are proud of the small part we are privileged to play in this outstanding achievement.

Galvanized work on these ships is first cleaned with a Pennsalt Cleaner to insure a finish which will withstand the extreme corrosive conditions of the sea.

Paint stripping is another important use of Pennsalt Cleaners at the B.I.W. In fact there is a Pennsalt Cleaner scientifically designed for nearly every type of metal and maintenance cleaning.

Our chemical engineers will be glad to demonstrate the benefits of Pennsalt Cleaners to you in your plant. No obligation. Write fully to our Special Chemicals Division, Dept. MA

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Application must be complete, including age, college, year graduated, degree, present employer, salary and salary expected; also inexpensive photograph.

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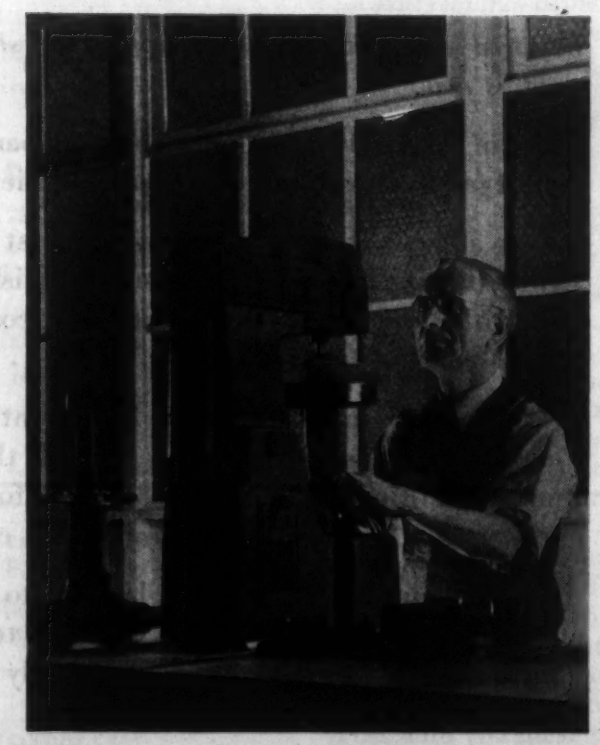

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when enameled are used satisfactorily for such foods as peas, corn, beans, carrots, beets and meats. It is anticipated that there will be an expanding post-war use of this type of tin plate in containers for coffee, biscuits, shortenings, dried milk, tobacco and oil.

—*Metal Finishing*, Vol. 42, Feb. 1944, pp. 77-79.

Welding Aero Engine Manifolds

Condensed from the Institute of Welding, Quarterly Transactions

After many experiments it has been shown that austenitic steels recommended by reputable manufacturers as "resistant to weld decay" suffer intercrystalline corrosion after welding when subjected to the Hatfield test.

To produce satisfactory welds, it is necessary to incorporate 3% Mo in the sheet and 3 Mo and 1% Cb in the electrodes. Satisfactory arc welds have been consistently produced with these materials. Arc welding has been shown to be superior to oxyacetylene welding in speed by reduction of distortion and in general mechanical properties.

The object of the Hatfield test is to determine the resistance of an austenitic steel to the grain boundary precipitation of chromium carbides. It consists of immersing the steel for 72 hrs. in a boiling aqueous solution of 98 gm. sulphuric acid (S.G. 1.84) and 111 gm. of copper sulphate crystals, made to 1 litre with water. The steel is heated to 650 C. (1200 F.) for 30 min. prior to testing.

This heat treatment causes the most deleterious form of carbide precipitation and, consequently, puts the steel in a condition when it has least resistance to intercrystalline corrosion.

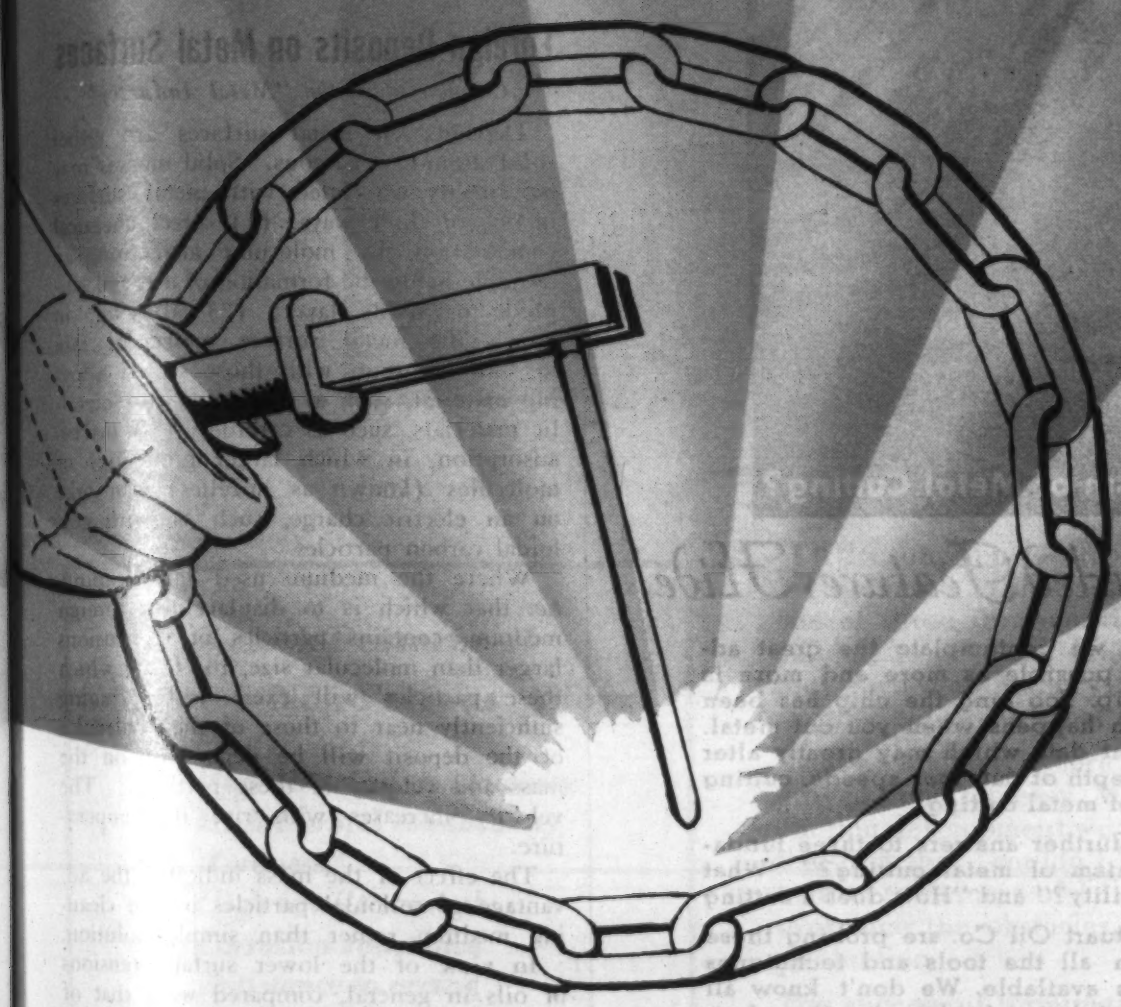
The ductility of a steel that has suffered no intercrystalline corrosion is unaffected by the test. A steel that is susceptible to attack loses all ductility, and will crack if bent. Such a steel will also show very little ductility in the Olsen test. The apparatus used for boiling the specimens consists of a beaker fitted with a reflex condenser, allowing for continuous boiling without change in the concentration of the reagent.

Use of high compression ratios with attendant high engine temperatures, along with the use of doped fuels, which may contain halogen compounds, has added greatly to metallurgical problems in aero engine manifolds.

The use of austenitic stainless steel was obviously appropriate, but adding to the problems was the fact that they had to be produced on a mass production basis. Manifold working temperatures are around 750 C. (1380 F.), this stainless steel (18-8) having useful properties up to 800 C. (1470 F.).

Welds made of straight 18-8 metal failed badly after the Hatfield test, and yet reasonably good results were obtained after this test with the columbium-bearing electrodes. When molybdenum was added

NOW you can GET these McKay Welding Electrodes



These Commercial Grades of Stainless and Mild Steel Welding Electrodes are now available.

McKAY STAINLESS STEEL ELECTRODES

(All Diameters .075"* to ¼")

18-8, Type 308
18-8 Cb., Type 347
18-8 Mo., Type 317
25-12, Type 309
15-35, Type 330
15-60
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25-20, Low Carbon-Heat Resistant

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12 Cr., Type 410
16 Cr., Type 430
18 Cr., Type 442
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McKAY MILD STEEL ELECTRODES

(All Diameters 3/32"* to 5/16")

No. 16—A.W.S., E-6020 & E-6030
No. 15—A.W.S., E-6010
No. 17—A.W.S., E-6012
No. 116—A.W.S., E-6012 & E-6013
No. 3—A.W.S., E-4520
in straightened and cut lengths or coil form for automatics
No. 19—Cast Iron

*We can now give good service on orders for small sizes such as—.075" and 3/32", formerly so hard to get, because of recent increases in our capacity for producing the smaller diameters.

An easing supply situation now makes McKay Stainless and Mild Steel Electrodes available for commercial purposes. A list of these two grades for nearly every type of arc welding, appears at the right.

If you have been having trouble obtaining the Electrodes you require, here is an opportunity to get these grades from The McKay "researched line." Inventories are being gradually built up which should permit a more consistent supply of most of these analyses both now and in the future.

Your inquiry or order will receive prompt attention.

General Sales Office: York, Pa.

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WELDING ELECTRODES . . . COMMERCIAL CHAINS . . . TIRE CHAINS

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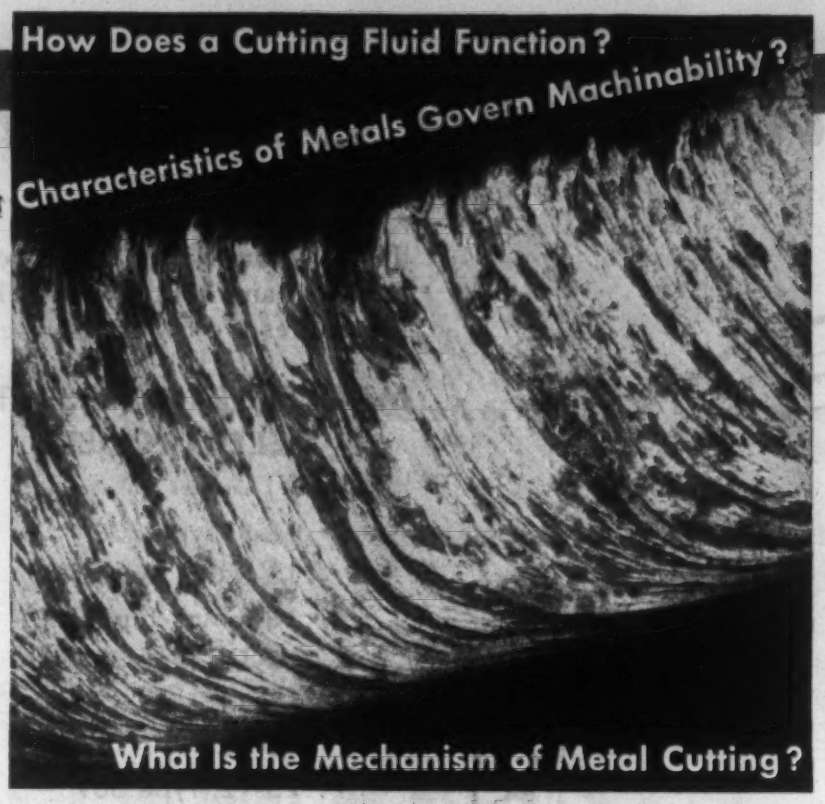

What Knowledge Its Gnarled Features Hide!

We're moved to poetic expression when we contemplate the great advances in metal-working which become possible as more and more is learned about the formation of a metal chip. Too long the chip has been taken for granted as just something which happens when you cut metal. Scientific investigation is bringing to light data which may greatly alter present day conceptions of tool angles, depth of cut, tool speeds, cutting fluids and other factors which are a part of metal cutting.

Through study of the metal chip come further answers to three fundamental questions: "What is the mechanism of metal cutting?" "What characteristics of metals govern machinability?" and "How does a cutting fluid function?"

We at D. A. Stuart Oil Co. are probing these mysteries with all the tools and techniques science makes available. We don't know all the answers yet, but we're learning them fast. As our research engineers inch closer and closer to the truth about the metal chip, their findings are reflected in improved cutting fluids—*to do a better job for you.*

We invite you to write for our new free booklet, "The 577th Oil," which contains twenty-two case histories, typical examples of how Stuart Oil Engineering is solving production problems (like your own), as well as other valuable metal-working data. Please state your name, company and title.

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Containers of all types are critically scarce. We urge you to cooperate with the W.P.B. program to conserve containers by observing these four rules for handling drums.
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3. Replace plugs carefully when drum is empty.
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to the columbium in the electrode, a completely satisfactory set of welds was produced.

Further refinements in the experimenting led to the conclusion that the only combination capable of producing consistently good welds is 18-8-3 type parent metal welded with 18-8-3-1 type coated electrodes.

—K. J. B. Wolfe. *Inst. Welding, Quarterly Trans.*, Vol. 6, July-Oct. 1943, pp. 123-134.

Foreign Deposits on Metal Surfaces

Condensed from "Metal Industry"

Deposits on metal surfaces are either solid, liquid or gaseous. Solid masses may be directly associated with metal surfaces in one of three ways: (1) direct chemical combination, by molecular attraction, an example being the formation of a metal sulphide or oxide layer; (2) alloying, in which the metal surface molecules mix in solid solution with those of an alloying material, such as solder, or non-metallic materials, such as carbides; (3) macro-adsorption, in which larger groupings of molecules (known as micelles) can take on an electric charge, such as with colloidal carbon particles.

Where the medium used for cleaning, *i.e.* that which is to displace the foreign medium, contains particles of dimensions larger than molecular size, the force which these particles will exert when coming sufficiently near to those of the molecules of the deposit will be dependent on the mass and velocity of these particles. The velocity increases with rise in temperature.

The effect of the mass indicates the advantage of colloidal particles in the cleaning medium rather than simple solution.

In view of the lower surface tensions of oils in general, compared with that of water, it is to be expected that the forces of adsorption between the oil and the metal will be greater than that between the water and metal.

In the case of combined deposits, such as the metal sulphide molecule, it is possible to rupture the combined grouping by chemical means, such as pickling to remove sulphides and oxides, or by alkali solutions. Physical forces cannot remove such deposits except by abrasion. Solders may require dissolution in acids or alkalis, or the application of heat.

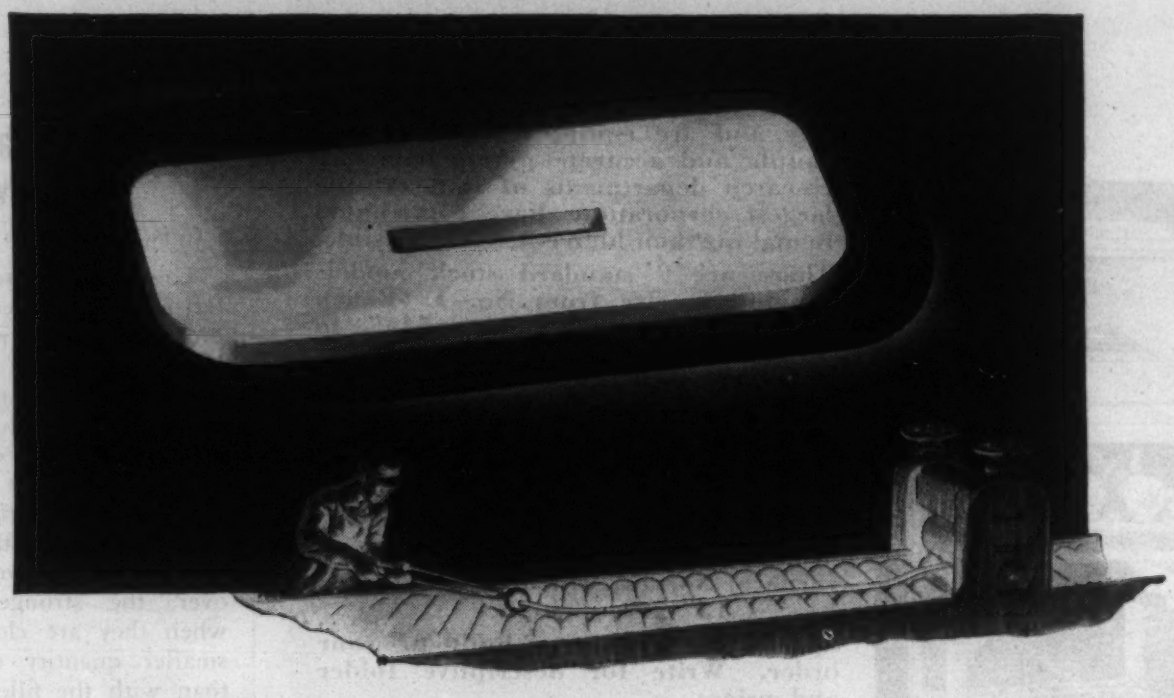
Free solid deposits are more easily removed by physical forces. Breakdown of larger deposits can be done by deflocculation, with the assistance of colloids. The deflocculated material may itself become colloidal, and the resulting particles assist in the breakdown of other solid masses. A degreasing solution is often more effective after a few days' running than when freshly made.

Liquid deposits are either superfluous deposits or adsorbed layers. The former can be removed by using a degreasing solution having a lower surface tension than that of the liquid to be removed. The removal of the second is more difficult.

As to the removal of gases, air displace-

It Couldn't Be Done

So Mallory Did It!



THIS tungsten electronic part, though much smaller in size than it appears in the picture, doesn't look hard to make. But it was one of those things which, in actual experience, turned out to be difficult to produce. Engineers put in many profitless hours before they turned to Mallory for help. They had already been advised by another consultant that the problem couldn't be solved.

Even at Mallory, where tungsten fabrication is a specialty, the job proved none too easy. Many hours of intensive engineering and production development were required to formulate a method to produce this part that "couldn't be made." Critical dimensions were actually held to tolerances of 1/1000 of an inch. But Mallory technicians did overcome the obstacles, and in fairly short order the part was in production.

The successful termination of this particular problem was only one of many on which Mallory skill has been brought to bear. Mallory engineers have had long experience with ferrous and non-ferrous metals, and have themselves produced such outstanding alloys as Elkaloy*, Elkonite*, Mallory 3, 53B, 53Z and 100 Metals. If you have a question about metallurgical properties or procedures, these same engineers are yours to consult. Meanwhile, write today for your free copy of the Mallory catalog on non-ferrous alloys.

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- √ *High electrical conductivity*
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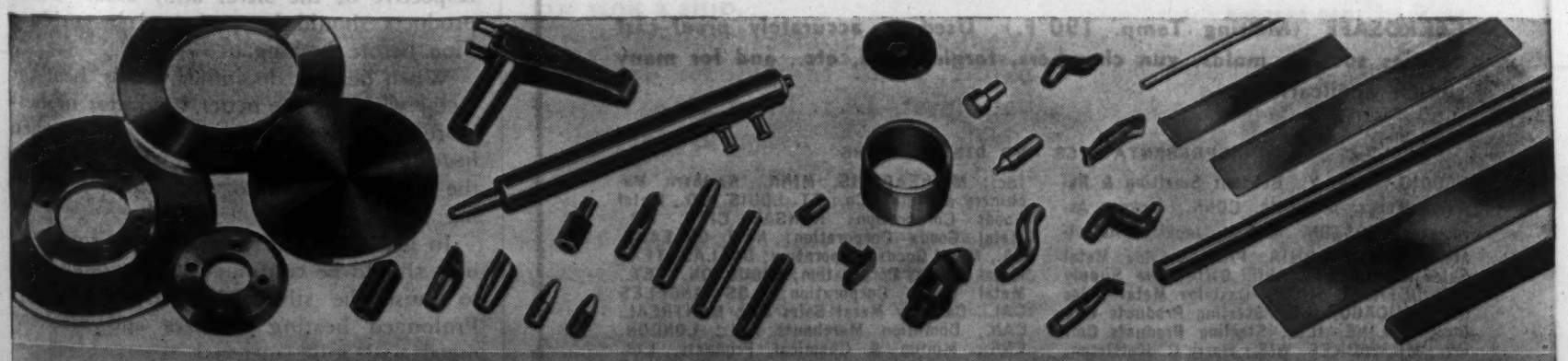

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AND 100 METALS—ELKALOY* AND ELKONITE*
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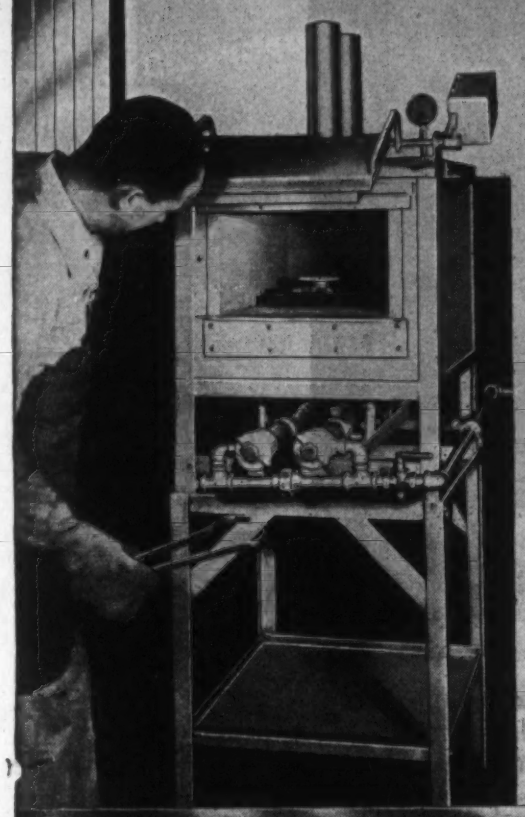

BAKER Blowerless Gas Furnaces are very low in gas consumption, noiseless in operation, reach the required temperature rapidly and are equipped with thermocouple and accurate pyrometer. The research departments of some of the largest corporations have contributed to making their high efficiency possible.

There are 9 standard stock models ranging in size from No. 1 (Bench type), which is 6" x 8" x 5½", to No. 24, which is 12" x 20" x 8" as illustrated. All provide uniform, controlled heat up to 1900° F.

Model No. 5, 6" x 12" x 5", is built especially for treating high speed steel. Gives uniform, controlled temperatures up to 2400° F.

We stock one Hydrogen Atmosphere furnace, No. 12, with a closed muffle 8½" x 15" x 2½" high.

Special size furnaces built to your order. Write for descriptive folder and prices.

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CERROMATRIX (Melting Temp. 250°F.) For securing punch and die parts, anchoring machine parts without expensive drive fits, short run forming dies and other metal-working applications.

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ment is usually easy if a solution of moderately low surface tension is used, or if mechanical agitation of the solution is employed. Jetting is particularly effective. In the case of adsorbed hydrogen, heat may be necessary.

—P. D. Liddiard. *Metal Ind.*, Vol. 63, Dec. 10, 1943, pp. 370-372.

Low-Temperature Brazing With Silver Alloy

Condensed from "Mechanical World"

Low temperature silver alloy brazing of ferrous and non-ferrous parts is used when greater strength is required than can be obtained by soft soldering. It is also used where the high temperature developed by electric or oxy-acetylene fusion welding would seriously distort the metal parts adjacent to those that are being joined.

Silver alloy brazing will prove economical because of the quick, free flowing properties of silver brazing alloy; moreover, the strongest joints are obtained when they are closely fitted and a much smaller quantity of silver alloy is used than with the filleted or V-joints.

In the selection of the brazing alloy, factors to be considered are the metals to be joined, corrosion conditions, type of joint and stresses to be applied.

Standard brazing alloys contain from 10 to 80% Ag, and those with lower percentages of silver have the highest melting points. Although the low-grade alloy costs less per joint, the advantage from their use is lost because of the high melting temperatures.

Brazing alloys with low silver are yellow, and the color becomes whiter as the silver content is increased. Alloys without copper and with high silver content are the whitest, but the band of alloy that is visible in a properly fitted joint is so narrow that color is negligible.

Silver brazing alloys are available in rod, wire, strip, sheet foil, fittings and powder. The size of wire, rod or strip should not be too large because of the waste.

Fluxes sometimes used are boron and a combination of borax and boric acid. Prepared fluxes that are fluid and active are preferable. The temperature required varies with different metals and alloys, irrespective of the silver alloy used. Metal products should be preheated by a blowpipe before brazing.

When heating dissimilar metals, heat the metal which is the better conductor of heat more than the other metal. Also, when heating metals of unequal thickness, heat the thicker section to maintain even heating.

In low-temperature brazing the source of heat should be continued long enough only to cause the silver alloy to flow freely. Prolonged heating oxidizes and weakens metal and joint material.

After brazing, allow the work to cool until the silver alloy is solidified. Nonferrous brazed joints may in most cases be water quenched.

—A. J. T. Eyles. *Mech. World*, Vol. 114, Dec. 3, 1943, pp. 642-644.

Official U. S. Army Signal Corps Photo

THERE'S A *New* HEAVY WEAPON ON THE CUTTING LINES, TOO - IT'S *Super DBL* HIGH SPEED STEEL

Available IN THESE FORMS

★ Hot Rolled and Forged Bars in all necessary sizes.

★ Ground Bars: rounds in sizes up to 3″ dia.—polished, standard ground or rough ground finishes.

★ Hardened and Tempered Tool-Holder Bits in sizes from 3/16″ to 1″, packed in one or assorted sizes as needed. Also special sizes as may be required.

NOTHING NEW TO LEARN IN HEAT TREATMENT OR SHOP HANDLING

IN the M-12 Tank Destroyer, above, Army Ordnance has combined the great hitting power and range of the 155 mm gun with the speed and mobility of the medium tank chassis. The result is a weapon that not only can stop any enemy tank now or likely to be in the field, but can blast out land strong-points or sink a ship.

In similar fashion, Allegheny Ludlum technicians have added cobalt to the familiar AL-developed DBL low-tungsten moly analysis. The result, *Super DBL,* is a high speed steel of maximum red hardness for heavy duty work—a material that delivers top performance at the same time that it conserves strategic materials.

Super DBL has been thoroughly proved in service. Use it for your heavy roughing and "hogging" jobs—it's suitable for anything from hard, gritty materials to tough, heat-treated alloy steels. ● Full information is available in the *"Super DBL* Blue Sheet." Write for your copy, or for the assistance of our Mill Service Staff in selecting the proper grades of AL Tool Steels for your various production jobs.

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C-F POSITIONERS

Save 72 Lifts

The Norberg Manufacturing Co., Milwaukee, have eliminated 72 lifts per unit by using a C-F Positioner on the production job illustrated. These complex weldments (Scavenging air headers for large Diesel engines) have to be "procedure-welded" and formerly required 72 crane lifts. which took an average of 20 minutes apiece. Now, the C-F Positioner moves the weldment through the routine positions under a push button control saving 24 hours crane time, 24 hours crane operator's time, and the same of both a sling man and the welder's time per weldment . . . in other words saving three man-days and one crane-day on each header produced.
C-F Positioners come in 6 sizes—capacities to 30,000 lb. All are pedestal mounted, rotate 360° and tilt to 135° beyond horizontal.

Write for Bulletin WP-22

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Also many other standard and special compositions.

ANODES:

Of all desired dimensions.

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For use with Silver Brazing Alloys.

Write for booklet "MA"

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EST. 1875

Aluminum Brazing Sheet

Condensed from "The Welding Journal"

Aluminum brazing sheet consists of an aluminum alloy core with a brazing alloy coating on one or both sides, metallurgically bonded to the core.

When properly heated above the melting point of the coating alloy and below the melting point of the core in the presence of an appropriate flux, a portion of the coating melts and flows into the nearest capillary spaces. But in the molten state, the surface alloy may diffuse into the core and be immobilized, or if the temperature is too high, some of the core metal may dissolve in and be carried along with, the brazing alloy.

Advantages in the use of aluminum brazing sheet are that no preplacement of brazing alloy is necessary; design considerations may take care of metal flow on and into the joint; capillarity insures that the coating flows to the required places if the brazing alloy surface is in substantial contact at a point or a line.

Brazing alloy, in the form of coating, will flow at a lower temperature than the same alloy in the form of added filler material. Tests show that for run joints, where the metal flows downward, the percentage flow of available brazing alloy is about the same for 1 and 3 min. at temperature.

Draw joints, where the metal flows horizontally, give a greater amount of flow than run joints with a larger amount for a 3 min. than for a 1 min. period. In anti-gravity joints, where the metal flows upward, the amount of metal is relatively small.

The temperature of 100% flow is dependent on the composition and thickness of coating and of core, the flux used, the type of joint, the length of flow path and the time of temperature. These factors must be fixed in order to identify this temperature.

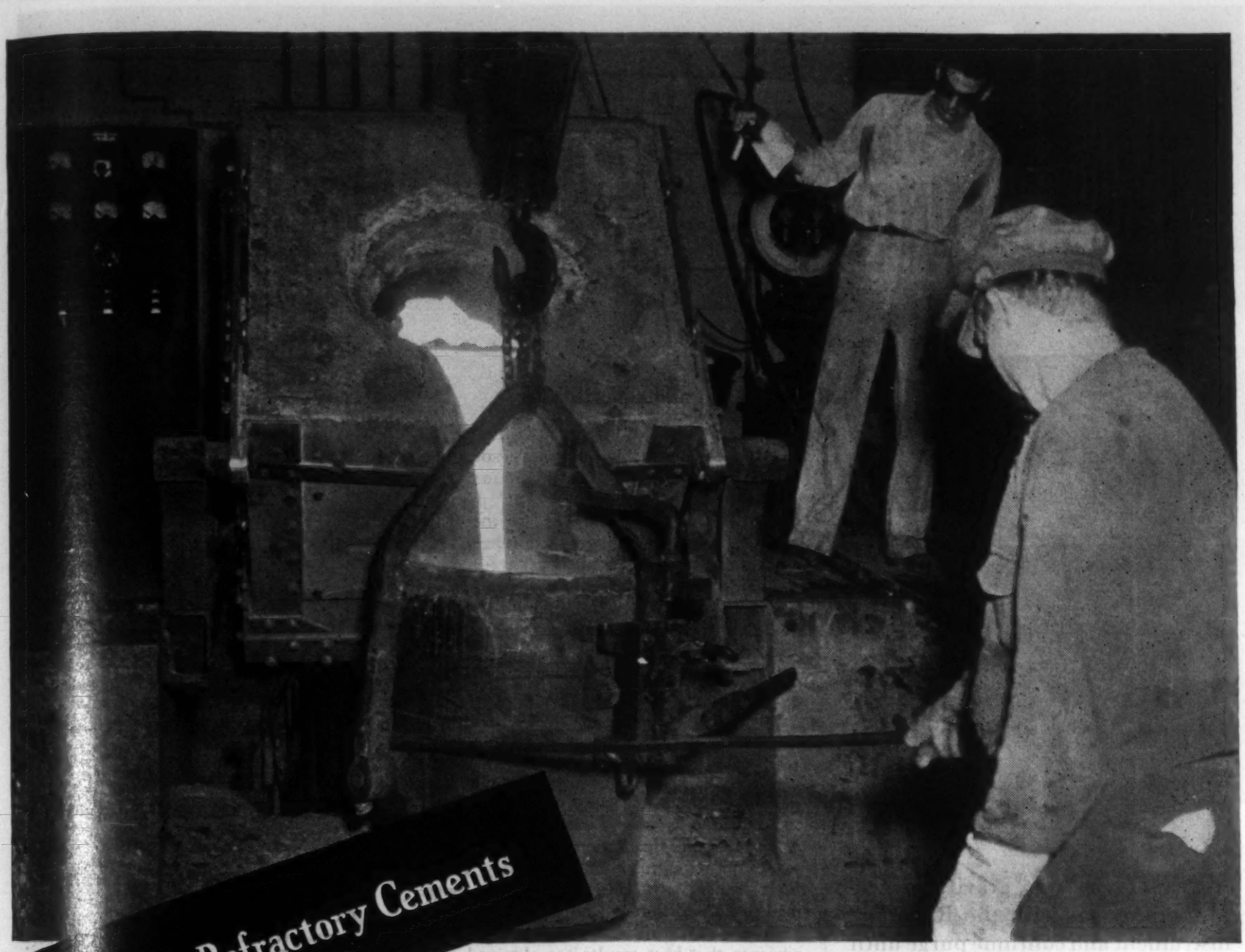
Design of Joints

In order to minimize fatigue failures at the joint, the fillet that joins one part to another should have a radius equal to or greater than the section thickness of the thinnest part, and 60% of the brazing alloy has been proved to be necessary to form a sound structure.

Cleanliness is of greatest importance. Precleaning solutions, trapped in the capillary spaces, will cause poor brazing response or even prevent brazing entirely. Hydrogen gas, generated during furnace brazing will cause minor explosions that result in misalignment of assembled parts.

The gas is formed by the water held by the flux even after fusion. It can be decreased by heating the water paste-coated surface at 230 F. for several hours. Molten brazing flux should be dehydrated by dipping aluminum into it until there is no further reaction.

It is almost impossible to obtain absolutely flux-free brazed joints of considerable contact area. If a live contact (as a curved surface tangent to a plane) is employed, the molten alloy displaces the flux from the center outward to form a flux-free fillet.



Norton Refractory Cements are finding wide and successful application in the melting of non-ferrous metals. Among these cements are:

RC 1131—a CRYSTOLON (silicon carbide) cement of high refractories for ramming into oil or gas fired reverberatory and pit furnaces melting aluminum. Also recommended for melting copper and zinc.

RM 1169—a fused magnesia cement, ideal for lining Ajax-Northrup high frequency furnaces melting nickel-chromium alloys.

RA 889—an ALUNDUM (electrically fused alumina) cement recommended for lining burner tunnels in gas or oil fired billet heating, heat treating and annealing furnaces.

RM 1140—a fused magnesia cement for rammed linings in Ajax-Wyatt low frequency vertical ring induction furnaces melting high copper alloys (more than 85% copper), copper-nickel alloys, nickel silver, and cadmium bronzes.

NORTON COMPANY
WORCESTER 6 MASSACHUSETTS

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Norton Longer Lasting Refractories

Instrument tells exact moment when FURNACE PURGE is complete

MEASURE specific gravity of generator gas with the Ranarex* instrument and continue purge until the specific gravity is the same at the furnace outlet as it is at the inlet. At that point you can be sure there's no air in the gas. Danger of explosion is reduced and over-purging for safety is unnecessary.

Helps control quality

Ranarex also makes it easy to maintain uniform composition. Just measure the specific gravity of the raw gas and atmosphere gas. The instrument is quick, accurate, easy to use. It contains no chemicals or fragile parts.

Free booklet will be sent on request to The Permutit Company, Department A17, 330 West 42nd Street, New York 18, New York. In Canada: Permutit Company of Canada, Ltd., Montreal. *Trademark Reg. U. S. Pat. Off.

PERMUTIT'S
RANAREX

In order to overcome grooving and perforation, the designer must make the "right" capillary the most positive one, and the operator must minimize the movement of parts during brazing. After brazing, all traces of flux must be removed.

—M. A. Miller. *Welding J.*, Vol. 22, Dec. 1943, pp. 596s-604s.

Diamond Turning

Condensed from "Automobile Engineer"

To measure the surface finish of aluminum alloy pistons, bearings, and commutators finish-machined with diamond tools, an instrument known as the Talysurf is used. With this equipment two indications are obtained: a meter reading of the average height of undulations, and a graph showing size, shape and depth of undulations. Since the average meter reading alone does not give sufficient data, the total spread, or "straddle," was taken into consideration.

The main criteria considered desirable were low meter reading, a good graph, and good visual appearance. To obtain a good finish, tools had to be lapped to a high degree of precision, and the condition of the machine is also of major importance.

Tests were made on aircraft pistons made of wrought aluminum alloy RR5a. Four runs, each on 100 pistons, were made with different tools. Cuts made with various tools confirmed previous experience that best results are obtained with a tool having a facet set parallel to the work.

A widely held theory is that diamond turning should be carried out at the maximum speed. Tests showed that for each machine and setup there was a definite limiting speed at which vibration set in. Tests were also made to determine the effects of various coolants, such as lubricating oil, soluble oil, paraffin, airblast and dirty oil.

From these tests data obtained were as follows: (1) Visual judgment of surface finish may be very unreliable; (2) machines should be properly mounted and vibration eliminated. Correctly mounted spindle is essential. Plain bearings are preferred.

(3) Tools should have a perfectly polished edge. At 100 magnification cutting edge should not show any fault; (4) tools should be set on or slightly above center, and if a tool with facet edge is used, the facet should be parallel to work.

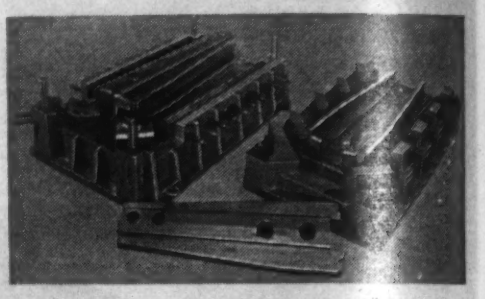
(5) Cutting speeds should be below natural vibration speed determined by fixture and work; (6) within limits, feed and depth of cut have little effect on quality of surface finish; and (7) although coolants do not greatly influence results, it is desirable to use a coolant to keep cutting edge free from swarf.

Results set out above should not be accepted unconditionally, since there is still a large field to be explored.

—*Automobile Engr.*, Vol. 33, Dec. 1943, pp. 531-532.

YOU CAN'T ESCAPE THE IMPORTANCE OF THESE FIGURES

Tractor top die (75% Strenes metal) 33⅓% less costly than like die of conventional metals. Weight 17,000 lbs. More than 500 hours of machining time, saved because the collapsible die, pressure pad, and cam blocks were so closely cast to shape. Important saving in raw stock also reported.



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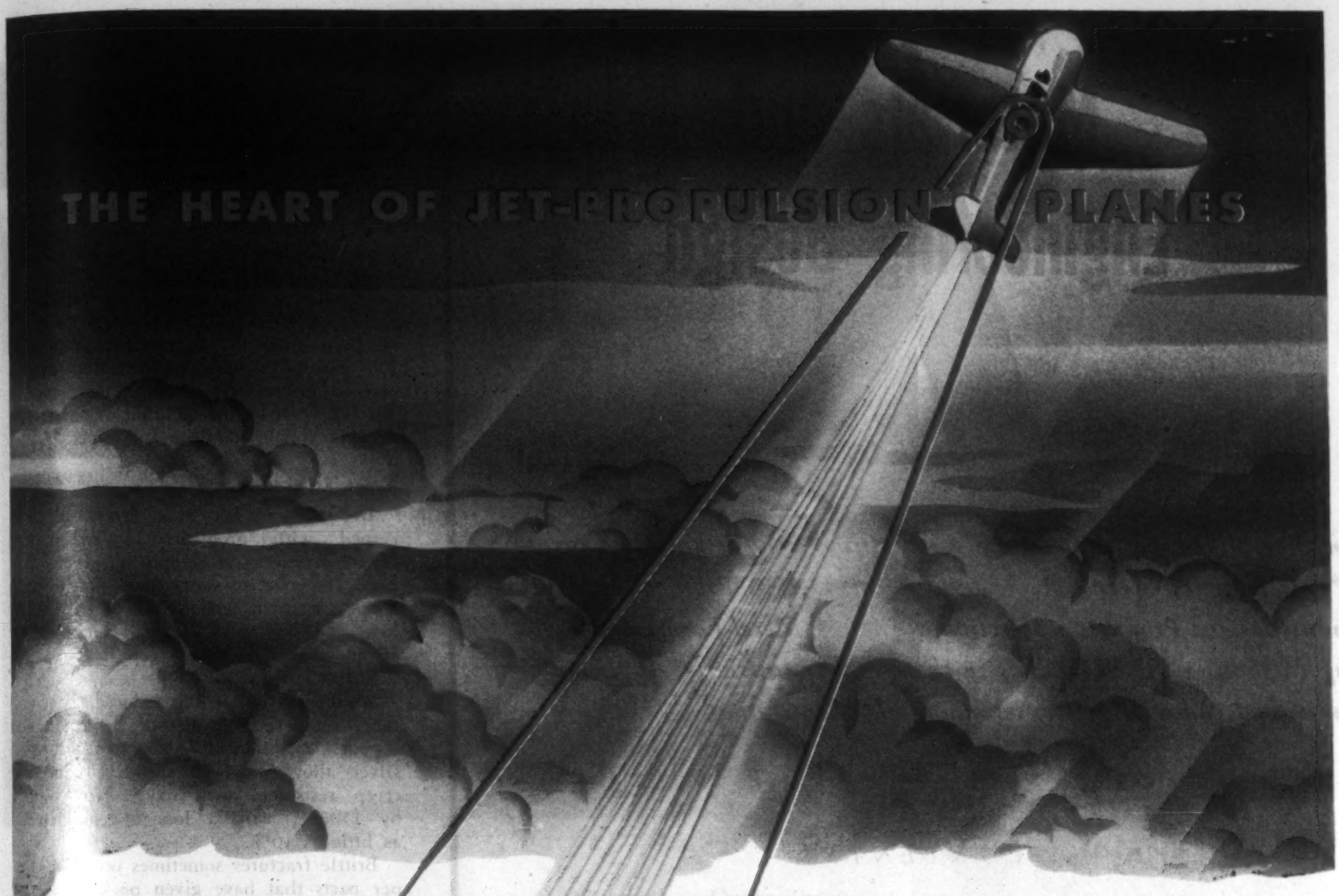
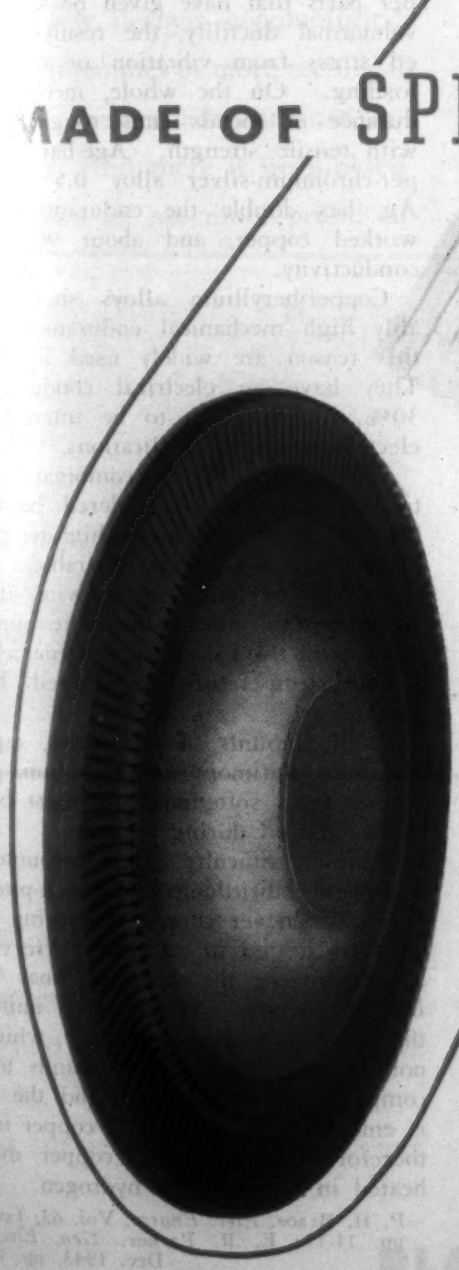


IS MADE OF SPECIAL TIMKEN ALLOY STEEL



A new Alloy Steel created by Timken metallurgists and introduced by the General Electric Company in their Turbosupercharger now plays a vital part in the G-E Jet-Propulsion Motor.

This new steel is tough. It's a steel able to resist the terrific heat created by hot gases passing through the vanes of the turbine wheel and also the tremendous centrifugal force developed in the wheel while spinning madly at thousands of revolutions per minute. Ordinary alloy steels would disintegrate if subjected to these gruelling demands.

In addition, this new Timken Alloy Steel has excellent weldability, good machinability, and high resistance to scale and corrosion at operating conditions. An impressive list of qualities, but everyone of them necessary to provide a practical jet propulsion power plant.

The big part Timken Alloy Steels have played in the past and are now playing in the war, emphasizes the promise that they will be of steadily increasing value in peace. Steel and Tube Division, The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN

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ALLOY STEELS

4 Materials and Engineering Design

Engineering Properties of Metals and Alloys • Resistance to Corrosion, Wear, Fatigue, Creep, etc. • Engineering Design Problems of Specific Industries and Products • Selection of Metals, Metal-Forms and Fabricating Methods • Non-Metallics in the Metal Industries • Applications of Individual Materials • Conservation and Substitution

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Modern Copper Alloys

A Composite

Early workers in copper were aware that the response of the metal to cold-working and annealing was not uniform. In recent times it has been found that quite small amounts of certain metals would alter this response.

Silver, even in small quantities, greatly increases the thermal endurance of cold-worked copper, and arsenic and more recently tellurium have been used to obtain the same effect. While these gains are helpful in dealing with ordinary operating temperatures, something more is needed when higher temperatures are encountered.

The precipitation-hardening alloys, as distinguished from the solid-solution alloys with tin, zinc and nickel, have a solid-solution condition stable at high temperatures, but not at low. When quenched from an appropriate elevated temperature, the solid-solution condition is retained at room temperature, but is unstable.

By reheating to an intermediate temperature, the solid solution tends to be transformed into a mechanical mixture. This is "precipitation." The desired increased hardness can be achieved in this way.

Copper-chromium and copper-chromium-silver alloys with chromium and silver lying between 0.3 to 1.0% and 0.0 to 0.1%, respectively, show high strength and relatively high conductivity in the aged condition, with great thermal endurance.

Beryllium-copper alloys show higher tensile properties and lower electrical conductivity than the copper-chromium combinations. Precipitation-hardening characteristics intermediate between these groups are exhibited by the addition of about 2% each of cobalt and iron to copper.

Creep Reduced

Designers are becoming increasingly concerned with problems of creep and fatigue in electrical equipment. Here tests have shown that slow creep occurred in copper at room temperature at stresses as low as 5,610 p.s.i. Small amounts of silver greatly decrease creep rates at 200 C. (390 F.).

A content of 0.078% reduced the creep rate to one-seventh that of the unalloyed copper. Addition of ½% Cr to a copper-silver alloy has been shown to increase creep resistance over oxygen-free copper by 1500%, with a loss of conductivity as little as 10%.

Brittle fractures sometimes occur in copper parts that have given no evidence of subnormal ductility, the result of repeated stress from vibration or other cyclic loading. On the whole, mechanical endurance of metals runs roughly parallel with tensile strength. Age-hardened copper-chromium-silver alloy 0.5 Cr, 0.1% Ag, has double the endurance of cold-worked copper, and about 90% of its conductivity.

Copper-beryllium alloys show remarkably high mechanical endurance, and for this reason are widely used for springs. They have an electrical conductivity of 30%, high enough to be interesting for electromechanical applications.

While most of the combinations mentioned have been considered because of high-temperature strength, high-temperature strength is not always desirable. In the enameling of hard copper wire, it is an advantage to anneal the wire simultaneously with the baking of the enamel. The baking temperature is limited by the enamel.

Small amounts of impurities, especially tellurium, antimony and cadmium, prevent copper from softening, and must be carefully removed during refining.

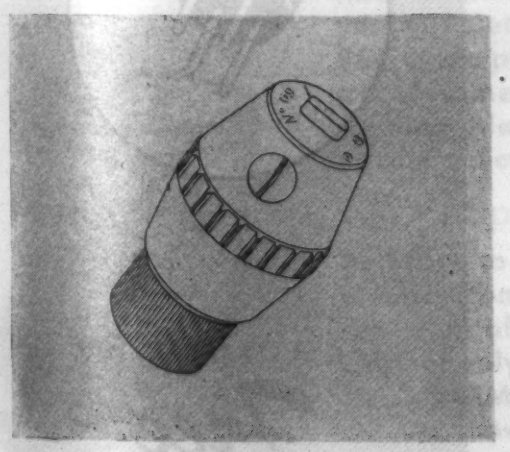
Another difficulty often encountered is hydrogen embrittlement of tough-pitch copper. Whenever copper containing copper oxide is heated in an atmosphere containing hydrogen, the hydrogen may diffuse into the copper. It will then unite with the oxide to form water vapor, which cannot escape. This vapor expands to form comparatively large holes, and the copper is embrittled. Oxygen-free copper is used, therefore, whenever the copper must be heated in contact with hydrogen.

—P. H. Brace. *Elec. Engrg.*, Vol. 63, Jan. 1944, pp. 11-17; E. R. Parker. *Gen. Elec. Rev.*, Dec. 1943, pp. 663-666.

DESIGN DATA ON PLASTICS

IV. An Interesting Case History FROM THE DUREZ LABORATORIES

There are few designs accomplished with Durez phenolics of more technical interest than the grenade and fuse described here. And there is no molded piece in which we are more proud to have had a part than this "exploder of the Nazi myth."



The designers' prayers for a versatile material were answered

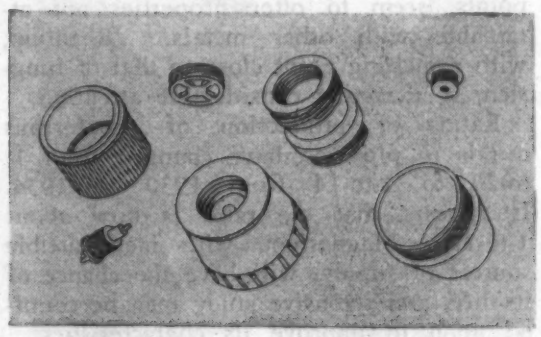
This seven-molded-part grenade and fuse called for some real designing ingenuity. And surely the designers' prayers for a versatile material were answered with the two Durez phenolics used.

The designers had to provide for fast production. Grenades are needed in enormous numbers. The moldability of Durez is a "spark plug" to speedy production. Two methods of molding were used . . . a reminder of the many advances which have been made in the faster molding of phenolics.

The designers had a worry (with a capital W) on their hands when it came to tolerances. There had to be molded-in threads, internal and external, and some very exact fits were obviously needed. Durez was the answer, with its moldability to extremely close measurements.

The designers were also up against severe service requirements. Grenades must work under all conceivable climatic conditions. Specifications were set up for a material with dimensional stability between −40° F and +170° F, and impervious to all kinds of weather. Furthermore, the material must not affect the explosive with which it is in contact. You know why!

These properties were all imparted to the same Durez phenolics which provided the desired moldability.



The designers were up against severe service requirements

All in all, this piece of "bad news for the super-race" gives you an idea of what can be accomplished when designer, material manufacturer and custom molder pool their talents. We welcome your inquiry on all plastic material problems and offer the facilities of one of the Plastics Industry's most experienced technical staffs in helping you work them out. Durez Plastics & Chemicals Inc., 94 Walck Road, North Tonawanda, N. Y.

DUREZ
PHENOLIC MOLDING COMPOUNDS AND RESINS

PLASTICS THAT FIT THE JOB

Metals of the Future

Condensed from "Mining and Metallurgy"

Metals of the past, now common metals — iron, copper, lead, gold, silver, etc. — are easily reduced from ores, and could have been found in involuntary smelting in hearth fires. Metals of the present include some, such as nickel and tungsten, unsatisfactory in crude form, and others, as aluminum and magnesium, which became available only when important chemical or metallurgical discoveries made their extraction possible.

For future development are a large number of unfamiliar metals such as titanium, reactive, refractory, and difficult to prepare; manganese, structurally complicated and peculiar; or beryllium, available in limited quantity and questionable purity.

Even rare elements may find use in industry in the future as alloying components. Germanium, very rare, forms a low-melting eutectic with aluminum, and can also function as a radio detector. Gallium and indium, with low melting points, seem to offer properties not attainable with other metals. Rhenium, with a melting point close to that of tungsten, is attracting considerable attention.

Ratios of production of non-ferrous metals to pig iron have changed from 1-to-20 to 1-to-14 from 1930 to 1934. It appears that the ratio is now about 1-to-12. Magnesium, with inexhaustible sources of supply, will have the chance of its life, and intensive study may be counted upon to improve its characteristics.

Aluminum is one of the most adaptable metals in alloying and heat-treating procedures, but ingenuity and aggressiveness will be necessary in pressing engineers to design for lightness as never before if the major part of present productive capacity is to be continued.

The most abundant metals are not always the most useful. Almost certainly calcium, sodium and potassium will not be used as base metals because of weakness and reactivity, although they are among the six most abundant. Titanium, said to resemble steel in mechanical properties, and not subject to atmospheric corrosion, zirconium, reactive at high temperatures, and used as a "getter" in vacuum tubes, and manganese, which can be held in plastic form by alloying, offer possibilities as base metals.

Chromium will probably be exploited principally in corrosion resisting alloys. Nickel is the outstanding example of a recent development of a relatively obscure metal to veritable indispensability. Vanadium, although possessing interesting corrosion resistance, will probably continue principally as a steel alloying element.

Some Rarer Metals

Cerium, yttrium, lanthanum, praseodymium and neodymium have been studied in Germany, but results have not yet been announced. These metals are very difficult to separate, but have been prepared as "misch metall," quickly corroding under atmospheric conditions.

Beryllium has probably not yet been prepared in pure enough form to determine properties of the element, but its uses in copper and as windows in X-ray tubes will require all the metal now available.

Uses of cadmium are limited by supply and price, but such applications as the coating of steel, as an element in bearing metals, solders, and fusible alloys, and for strengthening high conductivity copper will expand.

Barring some unusual discovery, there is little possibility that scandium will come into prominence. Thallium is useful in a small way, and tin and lead are well known. Hafnium, more abundant than lead, resembles zirconium in its properties, but shows little promise because of the expensive separation from zirconium. No large-scale uses for thorium can be envisaged at present outside the field of electronics.

Columbium and tantalum illustrate the progress in alloy technology. The former is used to prevent intergranular corrosion in stainless steels, and to reduce air-hardening in 4 to 6% chrome steels of low carbon content.

Tantalum finds wide use in chemical equipment. A large increase in future supply and demand would not be surprising. Antimony and bismuth will contribute useful properties to the low-melting alloys. Bismuth is one of two metals known to expand upon solidification.

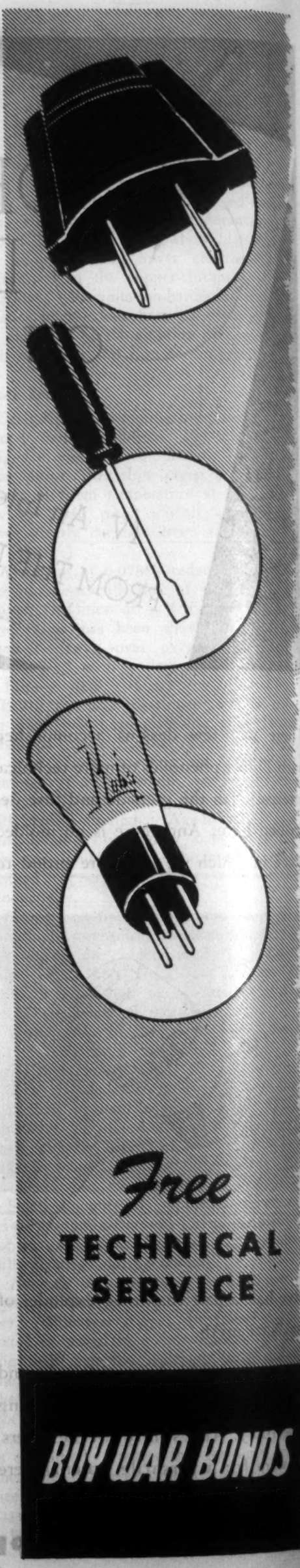
The high melting points, strength at high temperatures, hard carbides, etc., have made molybdenum and tungsten indispensable in lamp bulbs, X-rays and other tubes, high-speed steels, and various special alloys. Tungsten has the highest melting point (3380° C. or 6116° F.), the second highest reported modulus of elasticity (about 60,000,000 psi), and the highest strength (about 600,000 psi in 1-mil wire) recorded for any metal.

Interest in uranium at present centers in the structure and disintegration of the uranium atom as a potential source of atomic energy. Tellurium is being tried as an addition agent in lead for hardening, in copper for a combination of free machining, good hot-working, and electrical conductivity, and in steel and cast iron for mechanical properties and depth of chill, respectively. Cobalt, rather scarce and expensive, is especially prominent in hard magnetic alloys, cutting tools, and heat resistant alloys.

Palladium, platinum, and their associated metals, with gold and silver, are limited in use by availability. Iridium can be cold-worked only with great difficulty. An early determination gives it the highest modulus of elasticity, 75,000,000 psi. measured with any metal.

[The author mentions, among others, "Metals and Alloys Data Book," by Hoyt, as a source of information.—Editors]

—C. H. Mathewson, *Mining & Met.*, Vol. 25, Jan. 1944, pp. 5-11.



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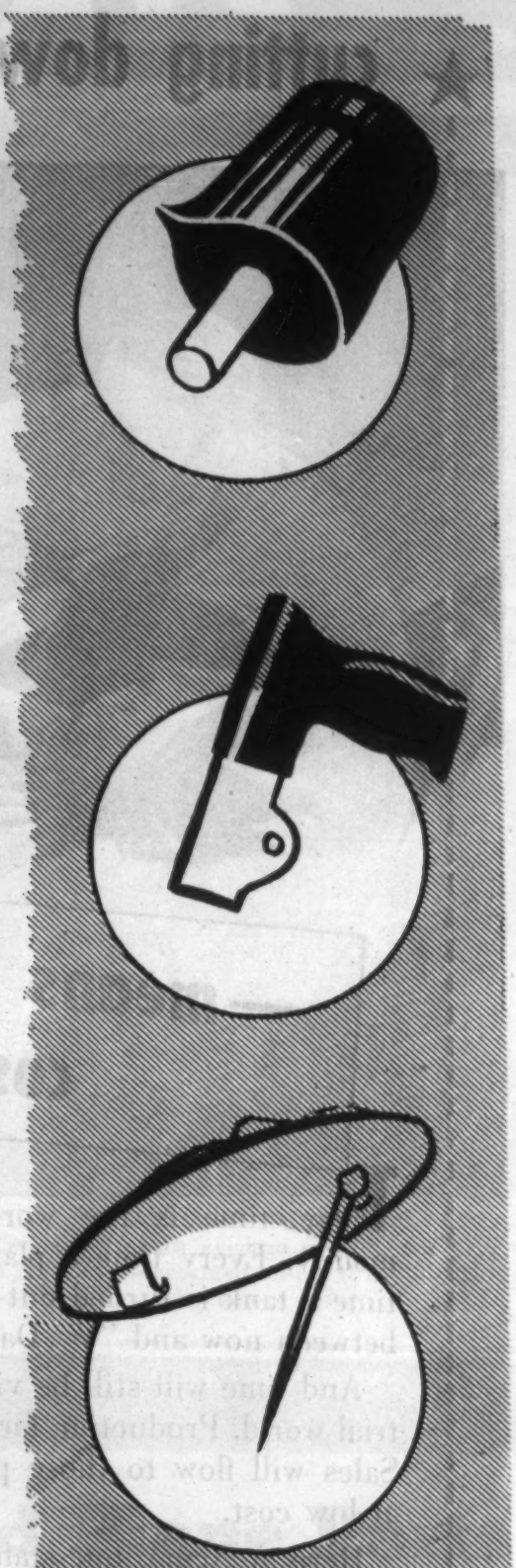
PLASTIC STRIPPER



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Army-Navy "E" Award received Jan. 12, 1943. White Star, for continued high production, received Oct. 30, 1943.

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TOOL DESIGNING . . . PRODUCTION PROCESSING

Magnesium in U. S. and Britain

Condensed from "Metallurgia"

The United States now leads the world in magnesium production. In Great Britain, until recently, priority demands of magnesium and its alloys resulted in a shortage for aircraft engineering, and replacements by aluminum alloys often became necessary; hence, progress in magnesium was retarded somewhat. Wrought alloys in Britain and the U. S. are almost identical as to major alloying elements.

In the wrought alloys field in the U. S. it has been held recently that the corrosion rates of some binary magnesium-aluminum alloys are decreased when their iron content is low. In alloys to which manganese has been added to enhance corrosion resistance, imposition of such low iron content is considered by British technicians to be probably unjustifiable.

Specifications as to minimum mechanical properties in the two countries are similar except as to Elektron AM 503 sheet and Elektron A.8 and Elektron AZM type forgings, for which U. S. minimums are higher than those of the D.T.D. requirements.

As to the chemical composition of the casting alloys, practices in the two countries diverge widely. Elektron A.8 and Elektron AZ.91 appear to hold little favor in the U. S., but instead, common usage dictates alloys containing 6 Al and 3% Zn; and 9½ Al and 2% Zn, with the usual manganese additions.

Americans like Dowmetal H, claiming superior test-bar mechanical properties and slightly superior corrosion resistance, but the British claim that it is more prone to porosity than the British counterparts. The British claim that the 6 Al, 3% Zn tends to hot-shortness, associated with its wide solidification range.

The British find that the beneficial effects of zinc are slight or often non-existent. For casting alloys, the impurity limits in the D.T.D. specifications are higher than permitted in the U. S.

A study of the mechanical properties of a precipitation treated commercial alloy — Elektron AZ.91 (10 Al, 0.4 Zn and 0.25% Mn) showed that the best properties are associated with fine precipitate, although the actual form of the precipitate is not critical.

Heliarc Process Interests British

Researches in Britain have resulted in improvements in quality of welding fluxes used and in production. As to the "Heliarc" process in the U. S., H. V. Pavlecka claims that it opens a new world of design opportunities to aircraft engineers, and he envisages the all-welded magnesium alloy plane.

It is claimed that the range of magnesium alloys that may be readily welded has been so greatly widened as to embrace all commercial magnesium alloys. When nitrogen is present to the extent of 7%, it reduces the welding speed to one-third of that when using pure helium.

The "Heliarc" process is particularly adaptable to the U. S., where there are large supplies of helium; the British are investigating the use of argon in its place.

YOU SAVE 4 WAYS . . .

REYNOLDS SKILLED WORKMEN do your fabricating for you. All that you need to do is furnish blueprints or templates, Reynolds takes care of the rest. Finished formed parts arrive at your plant ready for assembly, saving you valuable time.

IF YOU DO YOUR OWN FABRICATING, big areas like this are taken up by stock, machine, scrap. Take advantage of Reynolds modern, prefabricated plane-parts service and turn over that valuable space to other work.

THOUSANDS OF FREIGHT CARS like this one being unloaded can carry other war materials when plane manufacturers use Reynolds prefabricated plane parts. This Reynolds service does away with needless cross-shipping and handling of scrap.

ELIMINATE THESE HUGE SCRAP ACCUMULATIONS. Aircraft parts fabrication normally generates an average of 30% scrap. The Reynolds Plan keeps this carefully segregated metal at the aluminum source, where it can be put back to work without delay.

with REYNOLDS Prefabricated Plane Parts

ANY production method that can save airplane manpower today certainly deserves serious consideration. Add to this the saving of plant space, transportation and scrap handling and you have a combination that's unequalled in speeding plane production.

Just such a method is Reynolds Prefabricated Plane Parts Service.

It saves manpower because you receive finished aluminum parts ready for immediate assembly.

It saves plant space because you do not have to maintain excessive stock piles, do all your own fabricating or store and segregate your own scrap.

- It saves you transportation because it eliminates the need for freight cars to haul scrap metal from your plant.
- And it saves metal because the 30% of every aluminum sheet that normally becomes scrap during fabrication can be put back to work in our plants in a matter of hours instead of months.

Reynolds was the first . . .

The first aluminum manufacturer to supply finished plane parts from aluminum sheet 3 years ago, Reynolds is, today, supplying finished parts to every leading manufacturer of combat planes.

In that time Reynolds has built up the organization of skilled workers needed to make such a plan smooth-running, accurate, practical This forward thinking and co-operative planning has pushed Reynolds ahead to where it operations now cover 40 plants in 14 states with its own source of Bauxite from which aluminum is made.

This urge to "go places" is what keeps Reynolds men on a continual search for new ways to make aluminum better and easier, cheaper to use.

Take advantage of Reynolds' resources equipment and engineering skill. For any problem you may have in working with aluminum no matter what it may be, you'll find Reynolds prepared and able to handle it in the most practical way. Reynolds Metals Company, Aluminum Div., Louisville, Ky.

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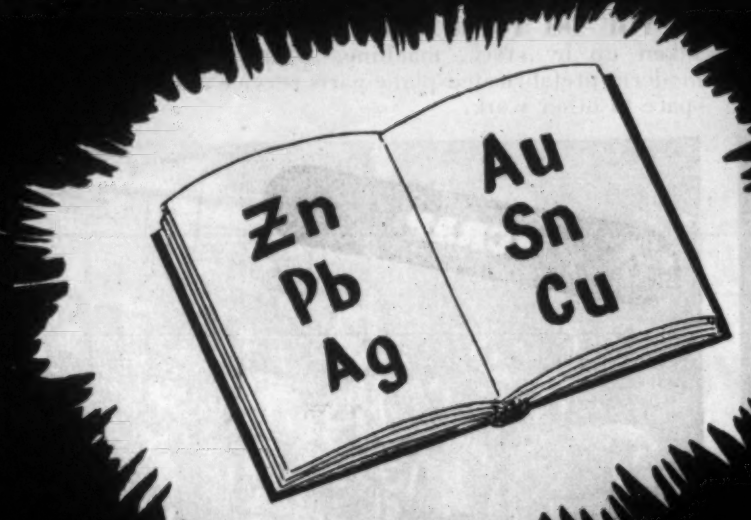
INDIUM

A New Era Opens for Non-Ferrous Metals



Until INDIUM came along, non-ferrous metals were handicapped by being quite vulnerable to corrosion and abrasion. Now, with slight additions of INDIUM in the form of a surface diffusion or more substantial quantities in the form of an alloy, non-ferrous metals have acquired high corrosion-resisting, wear-resisting and other properties.

INDIUM-Treated bearing metal, for example, exceeds prewar bearings in service life. INDIUM-Treated lead is much stronger and harder than pure lead. INDIUM solders have pronounced bonding strength, coverage and spreadability. INDIUM plating produces hard, durable, tarnish-resistant surfaces capable of taking a high polish. Brazing operations are improved by the use of INDIUM.

Every user of non-ferrous metals, every plant doing plating, soldering or brazing—even those wishing to protect steel against corrosion—should investigate INDIUM.

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4-1C-1

As to corrosion, using high purity binary and ternary alloys of magnesium with aluminum and manganese, the tolerance limits for iron are higher for magnesium than for magnesium-aluminum alloys. Iron is responsible for galvanic attack.

Despite many experiments, no protective film has been found better than that formed in chromate baths. The British have developed a modified acid-chromate bath, containing only 75 ccs. of nitric acid per litre of water, with 150 grs. of potassium dichromate. However, such films should be considered as merely paint bases. Chromate coatings alone may be insufficient, hence the additional application of lanoline or an equivalent grease is recommended.

The proportion of magnesium alloys used in British war planes is less than that in both German and American planes, but the British magnesium shortages now no longer exist. From captured German planes an extensive use of magnesium forgings is noted, the more important being the engine mounts, dive brakes and supercharger impeller.

Germans used a high percentage of castings in the as-cast condition, without heat treating. Amounts of magnesium, and parts employed in, are very similar between the U. S. and Germany. There may be 850 lb. of magnesium in a modern bomber. The largest magnesium alloy casting made to-date in the U. S. is a pump base weighing 900 lb.

—F. A. Fox & G. Goddard. *Metallurgia*, Vol. 29, Dec. 1943, pp. 83-84, 96.

High Permeability Alloy

Condensed from "Archiv Eisenhüttenwesen"

Various types of heat treatment were tried on a very pure 3% Si steel with the object of producing the highest possible initial magnetic permeability.

Increasing the temperature had a favorable effect when annealing in hydrogen contaminated by small quantities of nitrogen. Increasing the nitrogen and carbon reduced the initial permeability considerably. The highest initial permeability was obtained by annealing in pure hydrogen or in a vacuum.

A pretreatment under oxidizing conditions before annealing in vacuum was very effective in producing a high initial permeability. Tests on commercial qualities of iron silicon alloys yielded similar results; in particular it was seen that, with vacuum annealing, steel with initial permeability values equivalent to that of alloys containing about 40% Ni could be obtained.

A plant for the full scale utilization of the process is now under construction.

—F. Pawlek. *Arch. Eisenhüttenw.*, Vol. 16, Mar. 1943, pp. 363-366; as abstracted in *Iron & Steel Inst. Bull.*, No. 92, Aug. 1943, pp. 128A-129A.

(Continued on page 967)

Natural Re-Aging Aluminum Alloy

Condensed from an Institute of the Aeronautical Sciences Paper

There has been considerable difficulty in maintaining properties in the heat-treatable aluminum alloys when operations require that the work be heated after hardening. A commercial aluminum casting alloy containing 5.25% Zn ages naturally to attain high strength, equivalent to standard heat-treated alloys, without the necessity of a previous solution or quench heat-treatment.

Troublesome heat-treatment problems may be eliminated in this way. Government specifications, including those of the Air Corps, give the alloy requirements equivalent to those of high strength heat-treated aluminum alloys.

When parts must be brazed after partial assembly, when in the heat-treated condition, the use of such an alloy is especially advantageous. Tests have demonstrated its ability to re-age naturally to regain high strength after exposure to temperatures as high as 1050 F. High strength is regained after three weeks at room temperatures, or 10 hr. at 356 F.

Early prejudices against the use of aluminum-zinc alloys were based upon the supposed low corrosion resistance of such alloys. More recent work has shown that the deficiency of these early experimental alloys was not caused by the zinc, but by the presence of zinc and copper together. Corrosion resistance, under salt water conditions, will be the controlling property.

Tests show that magnesium and zinc, in the absence of copper, possess excellent salt-water corrosion resistance. The 5.25% Zn alloy, containing magnesium but no copper, has corrosion resistance comparable to the heat-treated 7 Si-0.3% Mg alloy. It is not subject to stress corrosion cracking, and has a high endurance limit.

Another outstanding characteristic of the zinc-magnesium-aluminum alloy is its exceptional ability to withstand shock. In this respect, comparative tests show, it is superior to the common heat-treated aluminum alloys.

—Hiram Brown. *Inst. Aeronautical Sciences* paper, Jan. 25, 1944 meeting.

Stainless Steel Aircraft Exhausts

Condensed from "S.A.E. Journal"

Aircraft exhaust systems must be designed to withstand service conditions that include severe vibrations, and temperatures of 1000 to 1700 F., with the hot exhaust gases passing along the inside at relatively high velocities, while the outside may be subjected to rain and sea atmosphere.

Titanium-stabilized 18-8 stainless steel is satisfactory for most installations subject to such conditions. There are some places where columbium-stabilized steel is applied because of its higher yield and tensile strengths. The latter costs more and is somewhat harder and more expensive to work than the former.

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Even in cases where the operating temperature indicates that columbium-stabilized steel should be used, better cooling of the system may permit use of the cheaper steel and increase service life.

With properly stabilized 18-8 stainless steel, failures caused by intergranular corrosion from carbide precipitation need no longer be feared. Detailed examination of severe failures during the last three years disclosed no evidence of intergranular corrosion because of the constitution of the material itself, although two cases were found in which the effects of welding gave rise to such attack.

Investigation of the cracking of welds in thin stainless steel sheets showed that the welds tended toward brittleness as the amount of borax and boric acid increased in the constitution of the flux. Rigid control of the composition of the flux with respect to these constituents and to the slagging constituents has resulted in improved welding and more easily controlled work by new welders.

Flux being used now is compounded to be mixed with methanol under close control of particle size, and is kept continuously agitated so that the resulting paste is very smooth and uniform in consistency.

During the preceding investigation, it was discovered that bits of zinc alloy from drop-hammer dies could also produce cracks in stainless steel during annealing and other heating operations. Various experiments show that it is necessary to keep zinc away from contact with stainless steel at elevated temperatures, as it exerts a deleterious effect within a few minutes. Cadmium-plated bolts rather than zinc-plated ones should be used in exhaust systems.

—H. A. Campbell, *S.A.E. Journal*, Vol. 52, Feb. 1944, Trans. pp. 67-72.

Light Drive Fits

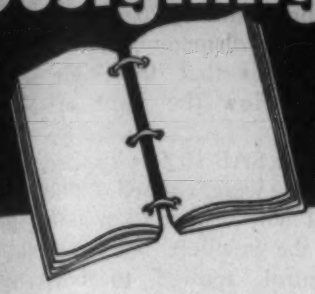
Condensed from
"Automotive and Aviation Industries"

To determine the probability tolerance limits on steel and duralumin bolts of various sizes, the Lockheed Aircraft Corp. tested 150 NAS-56-44 steel and duralumin bolts, both with a nominal diam. of 0.3742 in. Six readings were taken along the shanks, and bolts were divided into groups differing by 0.0001 in. in diam.

To determine the pressure required to drive bolts in assembly operation, a sample assembly to represent a joint on an airplane bulkhead was made up. Steel bars were heat treated to show 150,000 to 170,000 p.s.i.; for the square tube a hardness of 41 C Rockwell and tensile strength of 19,000 p.s.i. was established.

As a part of the project it was decided to determine proper drill sizes and tolerances, and also proper reamer sizes for rough and finish reaming holes for bolts in heat treated X4130 steel and 24 ST aluminum.

Designing Molded Plastics Parts: WALL THICKNESS

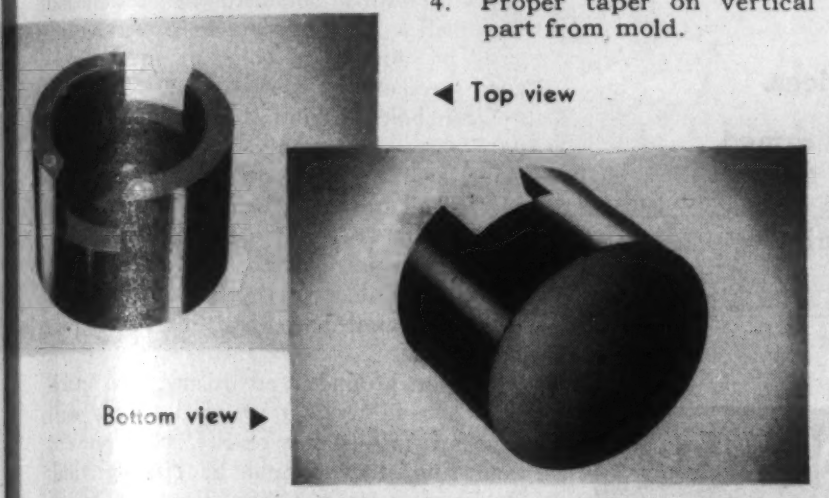


From the engineering files of One Plastics Avenue

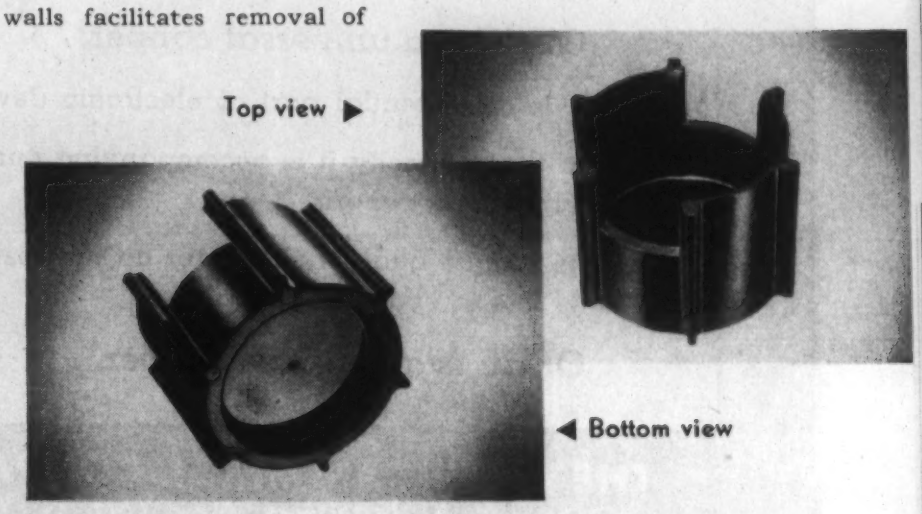
Requirements for wall thickness vary with the type of material used in the molded part and with the use to which the part is to be put.

When planning wall thickness for molded plastic parts the following general factors should be considered:

1. To obtain lowest manufacturing costs use minimum thickness that can be employed to produce a satisfactory part. Uniform thin sections speed molding cycle and cut cost of material.
2. Design walls of uniform thickness to eliminate uneven shrinkages and resultant stresses.
3. When both thick and thin sections are required in a molded piece, thick sections should be designed with cores or holes so as to permit uniform curing.
4. Proper taper on vertical walls facilitates removal of part from mold.



Original compression molded Textolite housing with thick walls, was relatively heavy and required long molding cycle.



Improved design of same housing makes possible shorter molding cycle, is lighter and adequately fulfills all functional requirements.

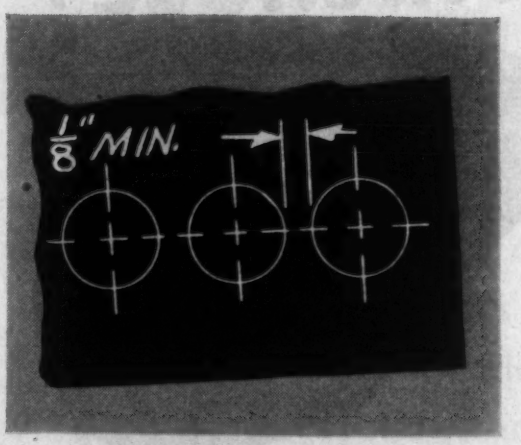
◀ STANDARDS ▶

COMPRESSION MOLDING

Generally accepted minimum wall thickness of parts is $\frac{1}{16}$". Minimum thickness will usually increase with size and ultimate application.

Urea plastics may be used for such applications as lighting reflectors with minimum wall thicknesses of .035" and maximum thicknesses of .125". Average for general use is .050".

Design vertical walls with draft or taper of 1° or more per side to facilitate removal from mold. $\frac{1}{2}$° is the minimum practical draft.



THICKNESS AROUND HOLES AND INSERTS

Thickness of material between insert and wall of any hole should be a minimum of $\frac{1}{16}$", between any two holes, at least $\frac{1}{8}$".

INJECTION MOLDING

Thin-walled sections chill quickly and neutralize injection pressure. Avoid sections of less than .050" unless paths of material travel are short and high pressures are available. In all cases .020" is minimum wall thickness.

G-E mycalex parts should have a wall thickness of at least $\frac{1}{16}$", increasing with size of part. In practice, minimum thickness is governed by the area to be covered and the maximum distance material must flow.

Parts to be molded from G-E mycalex should have a taper of 4° per side to facilitate removal from molds.

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New reamers with tolerances of 0.0002 in. on circle diam. and 0.020 in. on pilots were used. The diameter of the finish reamer was set so that the high limit was 0.001 in. below the limit of NAS bolt.

Reamer fluid of SAE 10 was applied with a brush. Holes were reamed 0.0007 in. below nominal bolt diameter, or 0.001 in. smaller than the smallest bolts supplied.

Quality control applied to bolts revealed that many had diameters below the low limit set on NAS drawings, and duralumin bolts varied from nominal to 0.0012 in. less than nominal, which was 0.0007 in. less than specified low limit.

It was, therefore, impossible to establish a hole or reamer size on the basis of NAS drawings. It was decided to use steel bolts down to 0.006 in. below nominal.

From results obtained, the conclusion was that it is impossible to obtain either steel or duralumin bolts to meet tolerance specifications of + 0.0000-0.0005 in.

Steel bolts having a tolerance of + 0.000-0.006 in. are suitable for light drive fits if the proper reamer is used, and duralumin bolts with a tolerance of + 0.0000-0.0012 in. are acceptable, provided they are divided into size groups differing in diameter by 0.0005 in. Bolts should be graded by visual-inspection precision gages.

Reamers ground in accordance with specifications and used at specified speeds will have satisfactory service life. To prevent cambering, they should be circle-ground. To increase reamer life, they should be designed without a square at the chucking end for a better grip on the shank.

—Charles C. Calvin, *Automotive & Aviation Inds.*, Vol. 90, Feb. 1, 1944, pp. 24-25, 90.

Metals and the Steam Engineer

Condensed from "Steam Engineer"

A summary of advances in metals of interest to the steam engineer are recorded not solely for immediate use, but also as a stimulus, suggesting possible applications at present and in the future.

Steel castings resistant to heat and corrosion are being made in America from steel containing 10 to 14 Ni, 23 to 28 Cr, 0.2 to 0.45 C, 0.2 N (max.), 1.75 Mn (max.) and 1.75% Si (max.). The tensile strength is 35.7 tons per sq. in., and elongation 4 to 12% in 2 in.

Electrodeposition of brass on stainless steel and Monel metal is carried out in a nickel chloride solution acidified with HCl. The work is the cathode, using 6 volts that will apply 50 to 70 amps per sq. ft. A short reverse treatment in the solution gives a slight etch and better band.

Chromium vanadium tubes used in radiant superheater corroded severely. This is caused by flame impingement. It was found that an increase in air at the furnace wall eliminates flame impingement.

Results of corrosion tests showed that

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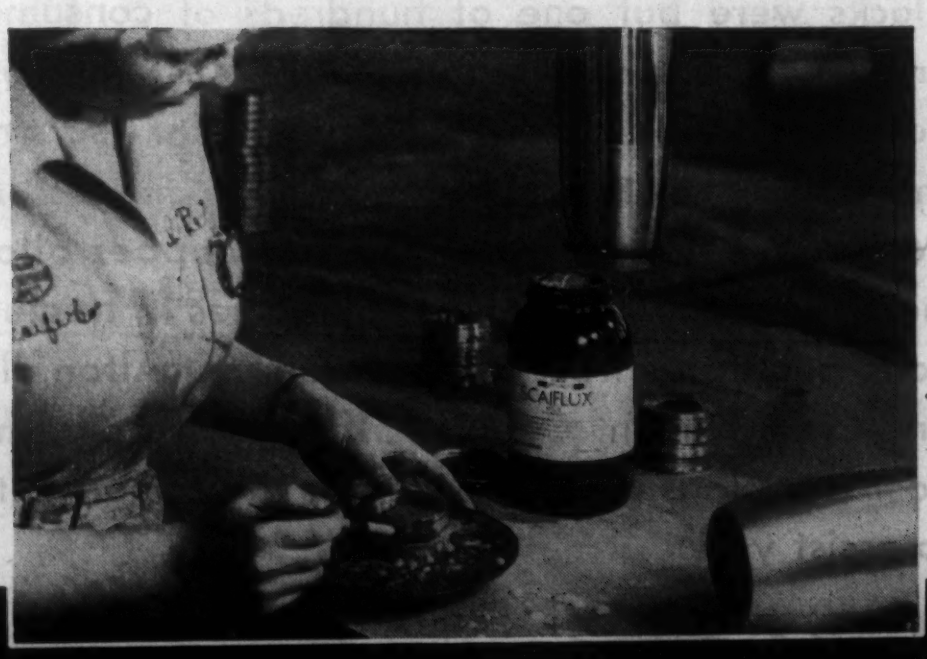

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18-8 stainless steel with molybdenum was not attacked by flue gases, although if alloyed with titanium and columbium it corroded. Little injury was done to 25-12 chromium nickel steel.

A new method of electrically welding tube strip into tubes is a combination of resistance welding and hammering. The current is supplied by disc electrodes, and the machine comprises a pneumatic or electric driven hammer between electrodes and edges to be joined.

Stainless steel is suggested for turbine rotors, buckets and nozzles, stellite for valve-trim, and special cast iron interior packing to reduce corrosion. A method of testing metal consists of plunging it into or coating it with a thin oil-soluble fluorescent agent. Excess liquid is washed off and coated with fine powder. The part is then studied under ultra-violet light.

A new steel with 0.7 to 0.9 Mn, 0.2 to 0.3 Si, 0.15 to 0.25 Mo, and 0.2 to 0.7% C replaces chromium vanadium steel for tubes. Steel should also contain 0.2 to 0.5 Cu. Seamless tubes (6 ft. by 60 ft.) are rolled radially with rolls acting upon internal and external surfaces. Longitudinal movement is accomplished by setting the roll axes obliquely.

Strong cast iron resistance to heat contains 3 to 3.3 total C, 0.3 to 0.5 Cr, 0.6 to 0.8 Mn, 0.3 to 0.5 Mo, 1.0 to 1.5 Ni, and 1.2 to 1.7% Si. Good results were otbained as regards mechanical properties and growth at 1212 F.

Turbine cast parts are being made from special molybdenum and chromium steels. Various heat treatments for the different steels are necessary.

A tin-free gear bronze consists of 90.5 Cu, 7.5 Sb, and 2.0% Ni. It is especially useful with thin-walled bushes and thin, sectioned blanks, and with centrifugal castings.

Low-alloy steels are replacing high-alloy steels for many purposes. A chromium-molybdenum-iron alloy is used for parts exposed to corroding conditions in Germany. It has 22 Cr, 1 to 3 Mo, less than 0.1% C, balance iron.

Chromizing is designed for high wear and corrosion resistance. Nickel in austenitic heat resisting steels is being replaced by nitrogen in Germany. Protective coating of steel, zinc and wood by spraying on a molten resin is a Swedish process.

—L. Sanderson. *Steam Engr.*, Vol. 13, Dec. 1943, pp. 76-78.

Replacing Extrusions with Rolled Sections

Condensed from "Western Flying"

Because of the shortage of extrusion facilities, it was decided to investigate the substitution of rolled formed sections from aluminum alloy strip for the simpler extrusions used on production airplanes. Several catalogues were compiled, the latest being "Catalog of Available Rolled Formed Section Equivalents for Extruded Shapes." Issued March 15, 1943.

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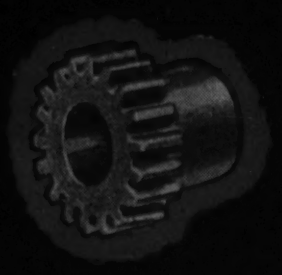
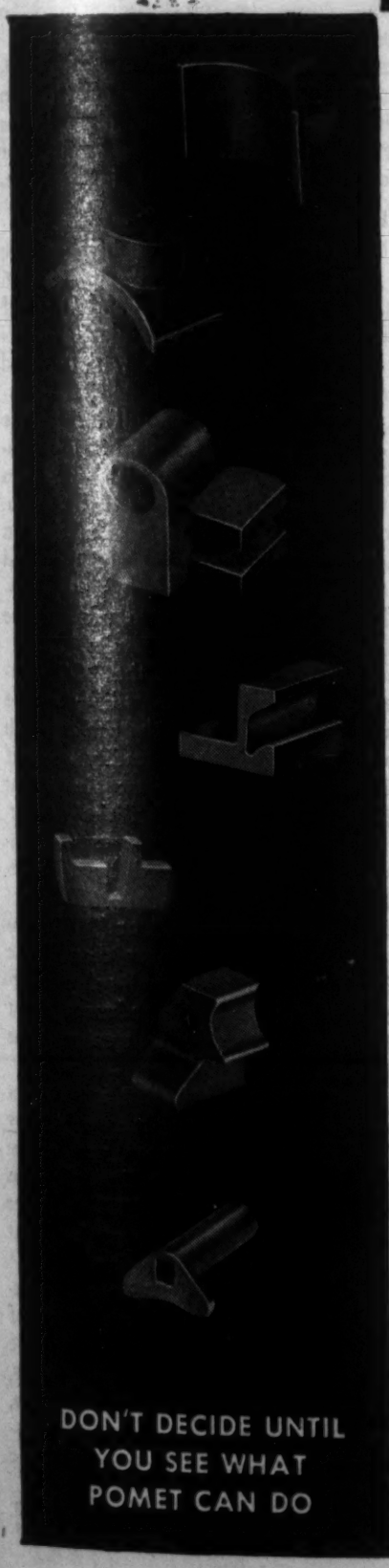


FROM POWDER
TO PARTS
WITH POMET



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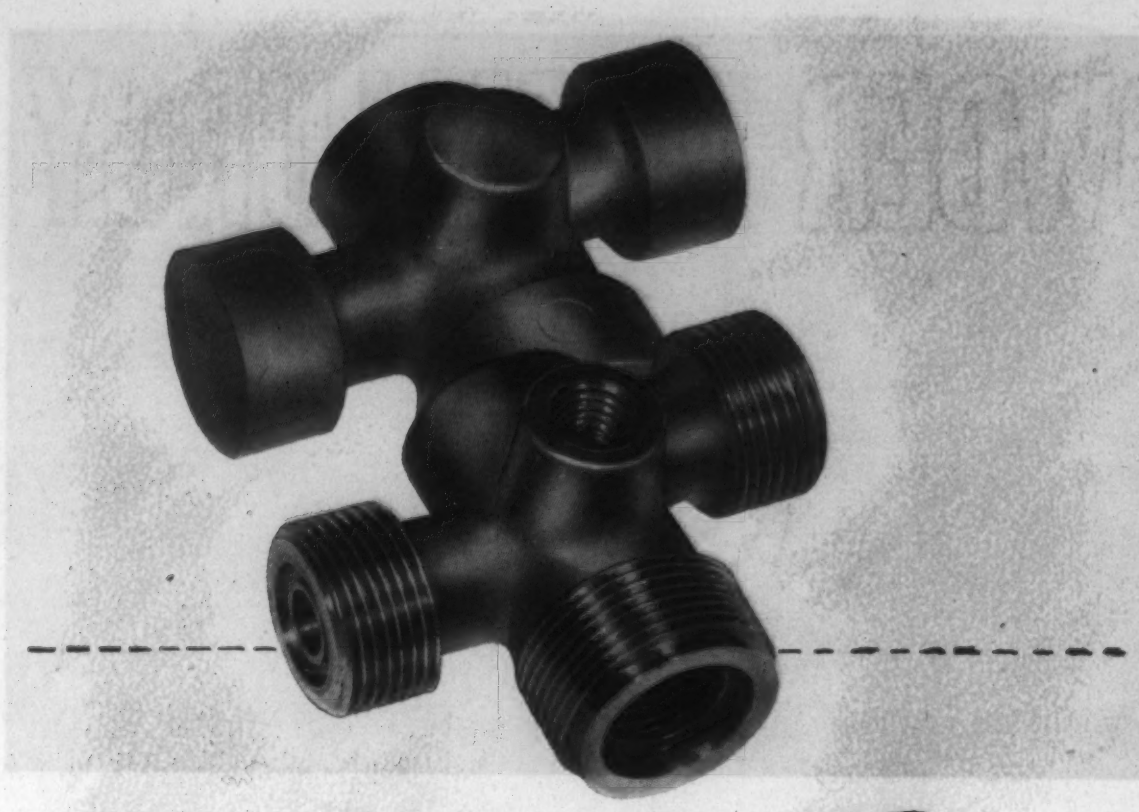

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The main points considered were dimensional and structural interchangeability between the extrusions and the rolled formed sections. Extrusions used in primary structural applications were tested structurally with the rolled formed section substitutes. Sections were tested in crushing and as columns, with all results corrected to nominal areas for both extrusions and substitutes.

Dimensional interchangeability, while secondary to structural, is the deciding factor, and is more difficult to maintain in most cases of possible conversion in currently produced airplanes.

The use of substitutes that required retooling or redesigning of bulkhead cutouts and mating parts was investigated as to advantages and disadvantages. Each section was considered individually.

The rolled bulb angles presented the most problems because of the difficulty in obtaining dimensional interchangeability while maintaining structural requirements. Investigation indicated that the smallest bend radii that could be produced would be the most desirable for most sections.

Better section properties are obtained, and many applications where substitution could have been brought about would be lost by using a large radius because of clearance troubles and rivet interference.

Inside Bend Radii

While past experience established the inside bend radii for 24ST at 3 to 6 times the material thickness and that of 24SO at 1 to 3 times, the minimum guaranteed inside bend radius was reduced to 1 to 1½ times for all 24S temperatures. It is possible to roll an inside radius of zero by rolling the sections under compression with special attention given to the section during fabrication.

Stretching of sections to straighten them after rolling in an "O" temper and heat treating improves the physical properties, but it is impossible to control the amount of stretching and its results.

Advantages of rolling in the "O" temper are that smaller bend radii may be more quickly produced and the brake bench or draw die may be more readily used if necessary. Disadvantages are that heat treating and straightening facilities are required, and heat treating removes the improvement in strength gained by the mechanical working.

Sections rolled in the "T" or "W" tempers are 10 to 20% stronger than those rolled in the "O" temper and subsequently heat treated. Another advantage of 24ST is that further heat treatment is eliminated.

Its main disadvantage is that it may restrict some rolling manufacturers whose equipment or experience may not allow them to roll small bend radii section in this temper satisfactorily. "W" temper material also requires equipment for heat treatment and prevention of aging.

Aside from relieving the shortage of extrusion facilities, the greatest advantage of using 24S rolled formed sections is the elimination of the anodizing finish process, required on all 24S extrusions. Also, these rolled formed sections may be assembled by spot welding in place of the slower riveting process.

—John Cramer, *Western Flying*, Vol. 23, Nov. 1943, pp. 48, 50, 104.

TYPES OF SUPERIOR TUBING IN MANY METALS—MAX. OD—5/8"

MECHANICAL—Analyses generally handled are SAE 1010, 1015, 1020, 1025, and 1035. They are used wherever tubes are machined, formed, bent, etc.

AIRCRAFT—Requirements of this industry cover every analysis. Major production is in SAE 4130X, SAE 1025, SAE 1010, Stainless Types 304, 321, and 347, Inconel and Aluminum. Government specifications in constant use are AN-WW-T-846, AN-WW-T-850A, AN-WW-T-855, AN-WW-T-858, AN-WW-T-861, and AN-T-43. Also certain AMS specifications, with reservations because of size range or availability of redraw stock. As substitutes become available, Superior will advise customers as far in advance as possible. Practically all of these changes will be forced by war conditions, but we are confident that the substitutes will be every bit as effective for the application as the material being supplanted.

INSTRUMENT TUBING—In this field, Superior furnishes hypodermic needle tubing, metal tubing for surgical instruments and parts, pointer tubing for electrical instruments, flattened tubing for Bourdon Springs. The hypodermic needle tubing is available in all standard sizes in the temper developed over a period of years, as most suitable for the application. The pointer tubing is generally aluminum where you get the combination of extreme lightness and maximum strength. For Bourdon Springs, Superior uses SAE 4130 X and Beryllium Copper.

CORROSION RESISTANT TUBING—In this category, Superior places the Stainless Steels, Nickel, Monel, Inconel, Copper and Aluminum. All of these are handled more or less regularly. The use of these alloys is indicated wherever you would find the problem of corrosion, whether because of acids, atmosphere, etc.

TUBING FOR ELECTRONIC APPLICATIONS—At the present time, Superior is furnishing Seamless Nickel, Monel, Inconel and Stainless. The tubes are used as anodes and cathodes in practically all types of Electronic tubes. In addition, we produce Lockseam Sleeves** made from Nickel strip and also some Lapsleeves made in somewhat the same way. Also tubing with special magnetic and glass sealing properties can be obtained. We urge you to get in touch with us when you are developing a design.

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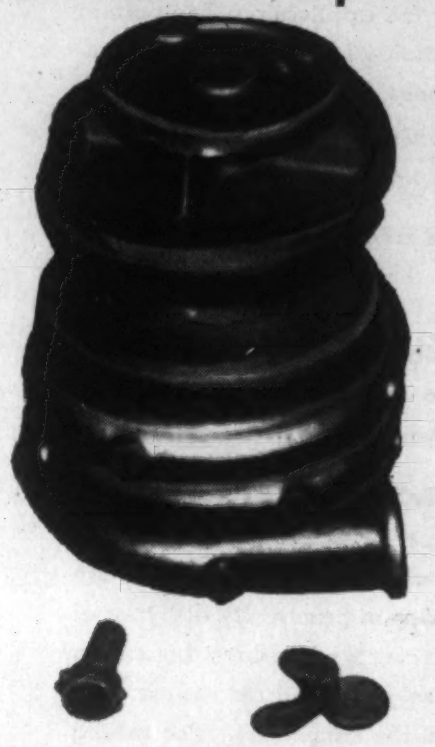

Every corrosion resistant casting has one particular job to do, and it is for this job and this job alone that Atlas castings are developed. If you have a Stainless Steel casting in the Blueprint stage, Atlas metallurgists can aid you best. For it is then that a consultation will perhaps save much redesigning. For your next corrosion, acid or heat resisting casting designed to do the job for which it is intended . . . consult Atlas. No obligation of course.

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Fatigue of Copper Alloys

Condensed from "The Metal Industry"

Systematic investigations of the fatigue strength of copper alloys has been made only in the last ten years, and it is probably because of lack of information on this matter that these alloys have not been used to a greater extent for parts subjected to repeated stress.

In 1933 a review showed that annealed copper rod had an endurance limit of about 4.5 tons per in., while that of annealed copper tubing was slightly higher. Cold-worked copper gave an endurance limit from 4.5 to 10 tons per in., the former value for excessively cold-worked material.

The endurance properties of copper, even in its annealed state, were found to be adversely affected by notches, fillets or any stress concentration, and copper was shown to be practically immune from corrosion fatigue in fresh or salt water.

It was known that additions of phosphorus, arsenic and antimony, which lower electrical conductivity, increased endurance properties. Within the tough pitch range oxygen appeared to have little influence on the endurance properties.

Tests had shown that wrought and nickel brasses were stronger in endurance than copper but more affected by corrosion fatigue. There were indications that they could be over cold-worked and were found to be susceptible to damage by notches or other stress-raisers.

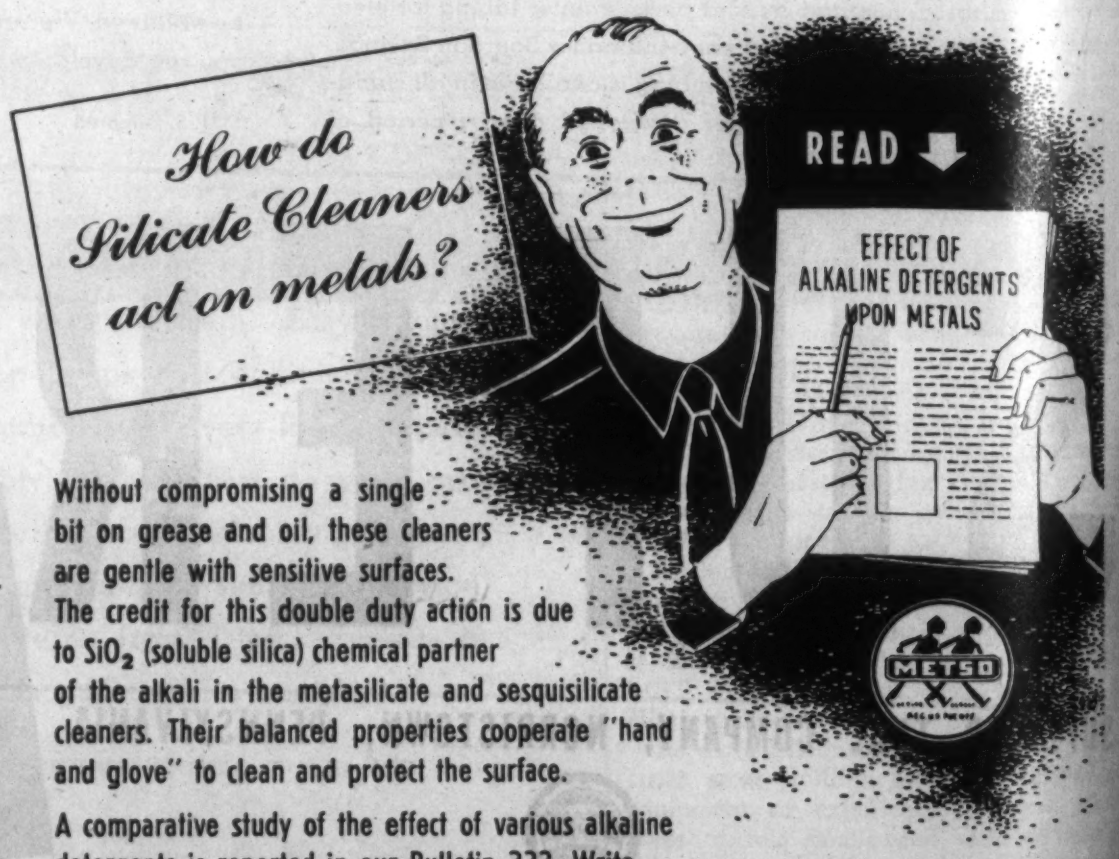
Phosphor bronze was proved relatively immune to corrosion fatigue in salt or fresh water but did not have a high endurance limit. Aluminum bronze was outstanding for endurance limit and corrosion fatigue resistance, and copper-bismuth alloys, with a precipitation hardening heat-treatment, appeared to have outstanding possibilities. Cast aluminum bronze, properly heat-treated, had almost as good an endurance limit as the wrought materials.

Brasses

Further tests on three brasses, 80/20, 70/30 and 60/40 alloys, show that their endurance limits range from 9.5 to 13.5 tons per in., and that fatigue properties are increased by cold-work, most effective when followed by low temperature annealing. Neither the proportional limit, elastic limit, proof stress or Rockwell hardness show a consistent relation to the endurance limit.

A series of high-speed fatigue tests at four temperatures on notched and unnotched specimens of cold-drawn brass proves that, in general, as the temperature decreases the endurance limit increases, and the stress concentration factor shows no consistent change.

Tests of each alloy of the copper-nickel series (1) cold-worked followed by low-temperature annealing, and (2) fully annealed, lead to the conclusion that the



Without compromising a single bit on grease and oil, these cleaners are gentle with sensitive surfaces. The credit for this double duty action is due to SiO_2 (soluble silica) chemical partner of the alkali in the metasilicate and sesquisilicate cleaners. Their balanced properties cooperate "hand and glove" to clean and protect the surface.

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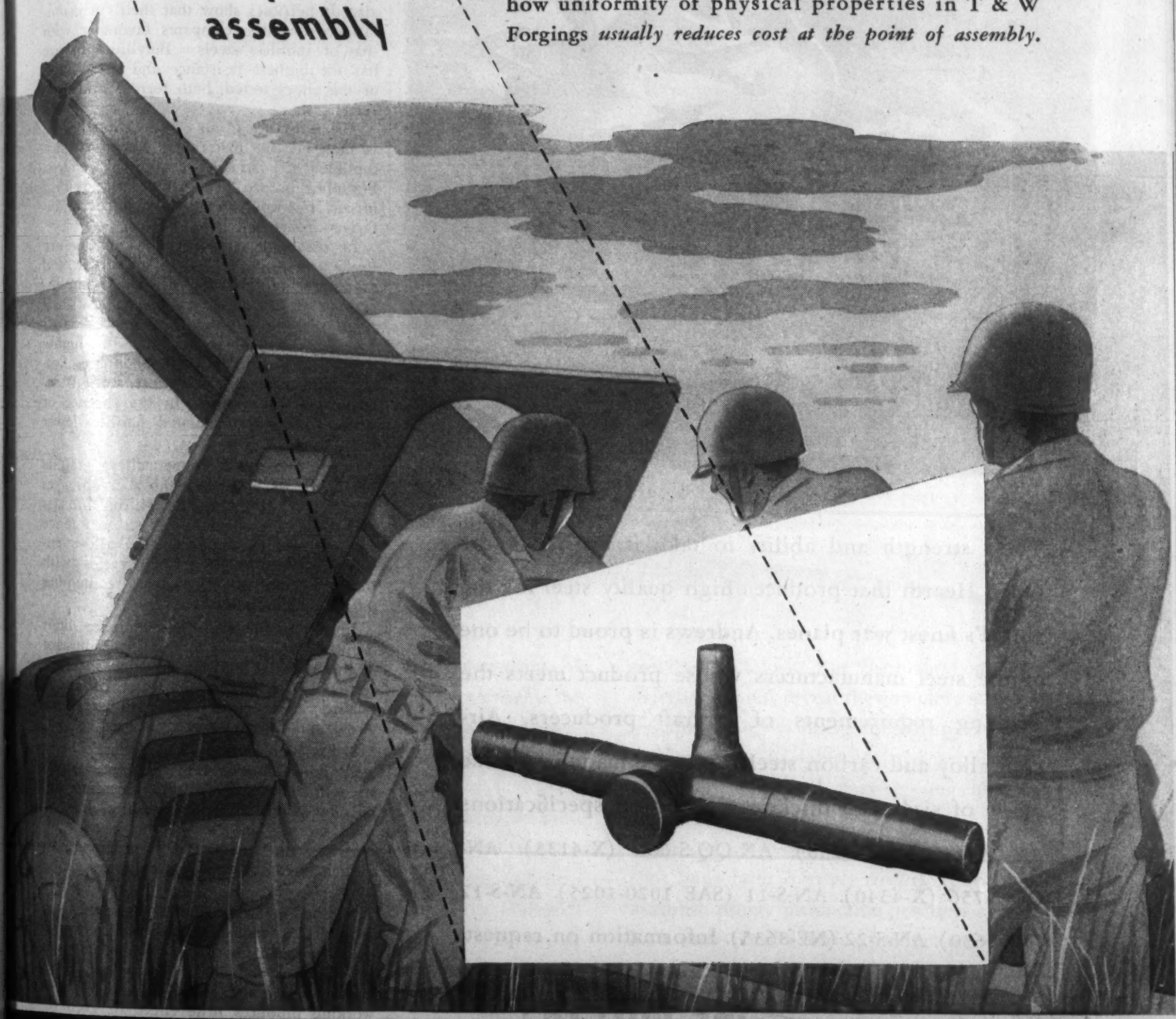

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whole binary copper-nickel system possesses a practically uniform value for the corrosion fatigue limit, except where the value of the limit is artificially depressed by the low value of the fatigue limit in air.

Fatigue strength is, in general, improved by the substitution of vacuum for air, and acid and alkaline impurities in atmosphere have little, if any, influence on atmosphere corrosion-fatigue of copper and brass, but oxygen in the presence of water is primarily responsible. Also, atmospheric corrosion-fatigue is unlikely to be due to the constituent impurities, solid or gaseous, in a metal.

Tests Upon Bronzes

Tests on four types of special bronzes to determine their suitability for special aircraft purposes show that their corrosion-fatigue resistance compares favorably with that of stainless steels. Beryllium bronze has the highest resistance and stress ratio of the alloys tested, both ferrous and non-ferrous.

The resistance in air of Superston bronze is high but the material is somewhat susceptible to stress-concentration effects. Phosphor bronze has a low fatigue limit in air, but comparatively good corrosion-fatigue resistance.

In sheet metals the highest endurance limits are observed in nickel silver and alloys of high nickel content. Grain direction affects fatigue value, and small grain size gives greater endurance. Small holes or additional working of highly stressed sections reduces the endurance limit, while proper surface preparation increases fatigue value. In the absence of surface preparation, plated finishes lower the fatigue resistance.

With cold-rolled copper alloys, results obtained for all the phosphor bronzes are superior to those for silicon bronzes and copper-nickel alloy. At stresses above 18 tons per in., none of the alloys endured more than a million cycles with the exception of 95/5 brass containing 0.03% of phosphorus.

In porous metals, the endurance limit decreases as porosity increases. Endurance is characterized both by reduction in cross-sectional area and some degree of stress-raising. The pores appear to exert external and internal notch effects.

It has been shown that the elastic limit, yield point, fatigue limit, ultimate tensile strength and hardness values increase and the elongation and impact values decrease with increase in the percentage of cold-drawing, and under all conditions the fatigue strength is higher than the elastic limit.

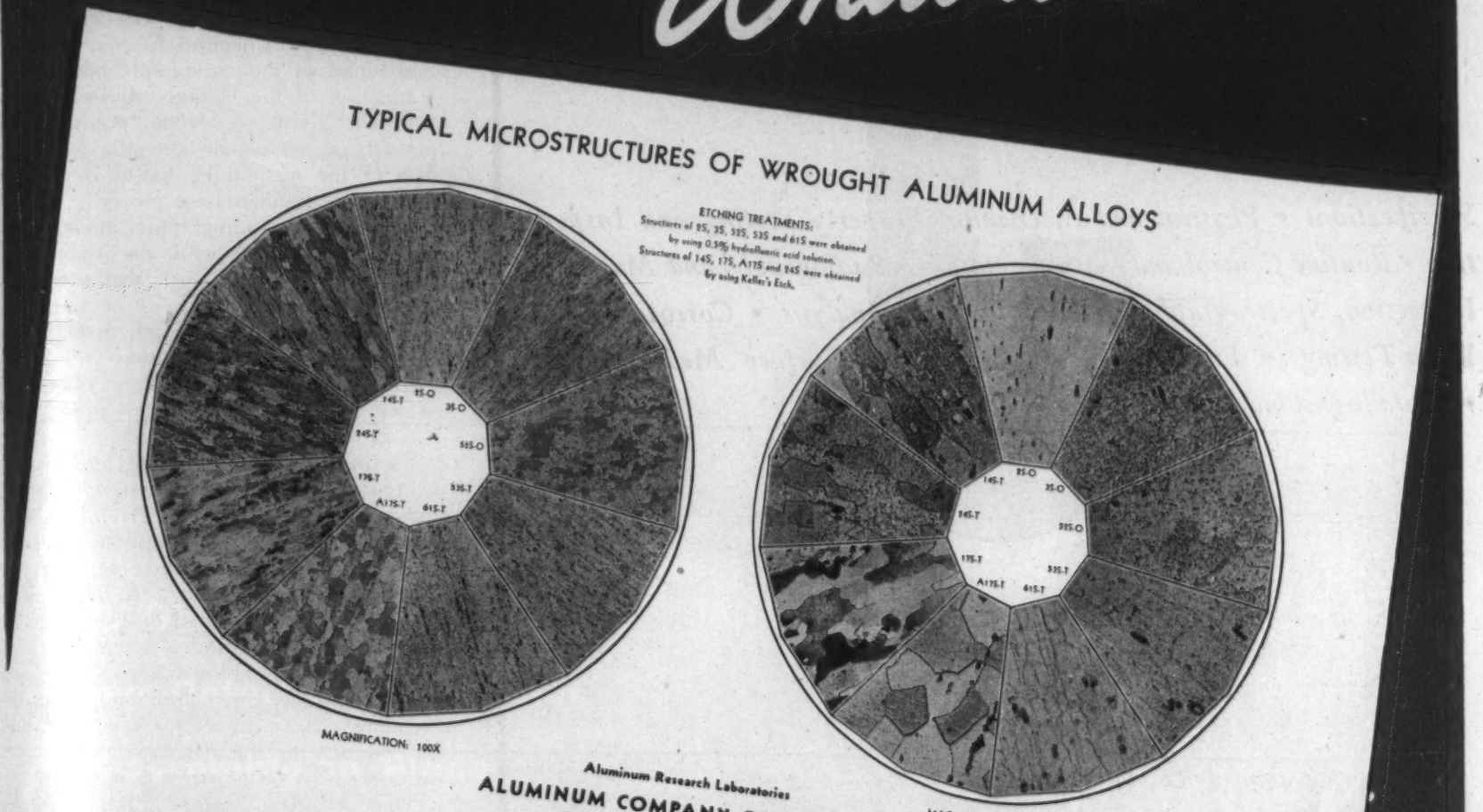
Recent investigations of the fatigue properties of industrial copper alloys prove that comparatively little initial cold-work on phosphor and silicon bronze raises the endurance strength rapidly, while further working produces little effect, or even reduces it.

In the precipitation hardening alloys, the effect of precipitation heat-treatment is not nearly so great on endurance strength as on tensile strength.

—J. W. Donaldson. *Metal Ind.*, Vol. 63, Sept. 17, 1943, pp. 178-180; Sept. 24, pp. 198-200.

TO HELP YOUR METALLOGRAPHER TELL

"What is it?"



This chart shows typical microstructures of wrought aluminum alloys. Copies are available for your metallographer's use as a reference in identifying these alloys. It will help him answer such questions as these—

Has a product been correctly treated *or mistreated* during fabrication? What physical changes have taken place during casting, working and thermal treatment? How complete are those changes?

Chemical analyses and mechanical tests are of invaluable aid to the metallurgist in determining the composition and mechanical properties of metals and alloys. But these methods, alone or together, do not reveal the complete story. Metallographic analysis bridges that gap. The metallographer is able to delve into the past history of a metal or alloy and answer such questions as those above.

This chart pictures microstructures of alloys that have been *correctly treated*. It will help you establish proper production practices and is useful on routine checks during production. For a copy, write ALUMINUM COMPANY OF AMERICA, 2162 Gulf Building, Pittsburgh 19, Pennsylvania.

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Interpretation of Radiographs

Condensed from "Light Metals"

Before a casting is condemned, the surface of the metal should be carefully inspected, and it may be that the surface irregularity is of little importance.

Slight folds, known as scabbing, and identification marks on thick sections produce such contrasted areas on the radiograph that care must be taken that minor irregularities are not mistaken for gross internal faults. A rule to follow is that visual inspection and radiographic interpretation must not be divorced.

It must be borne in mind that a film may be misleading, for what appears to be a case of bad cavitation may be due to small surface holes, which may either be small blows or gas cavities caused by gas pickup from the mold face. Such minor defects will often be removed during machining.

When cavitation appears in an acute form it should be ascertained by sectioning and polishing. This is done by rubbing down on increasingly finer grades of emery paper. If it is then found that the holes are contiguous with the surface, they may generally be ignored.

It is suggested that photomicrographs of a doubtful area, and a macrograph of a representative section of casting shown to be acceptable, should be filled with the radiographs of the same casting, in order that a standard may be formed for any part number. Radiography must be complemented by other methods of examination.

A system of quantitative correlation of radiograph and casting was evolved by Busk, of Dow Chemical Co., in which illumination of the radiograph, measured as a function of the voltage required to give sufficient light to define porosity, was plotted against tensile strength. A weakness of the method is that it is only applicable to standard test pieces.

In England, radiographic interpretation tends to be vague, while in America the design of castings is such that the allowable stress permitted is ½ of the specified ultimate tensile strength of separately cast test bars. When castings will not be loaded to produce stresses of over 20% of the allowable stress, such castings need not be radiographed.

Castings that may receive loads of 20 to 100% of the allowable stress must be radiographed. Castings of this second class are assessed by reference to stress loading applied to the three poorest castings in a batch of 100. If the weakest casting stands up to load of 1½ times the design load, the casting is acceptable.

Gas porosity, blowholes, segregation, micro-shrinkage, dross and sand inclusions are only certain causes for rejection when the location of the defects is such as to cause them to act as stress-raisers.

The American ratio "design-load of casting specification-test bar-ultimate stress" is different from British designed castings, for whereas the British sand cast test bar is of 1 in. diam. machined to gage dimensions, the American test bars are cast roughly to shape with a minimum of machining.

—*Light Metals*, Vol. 6, Dec. 1943, pp. 582-583.

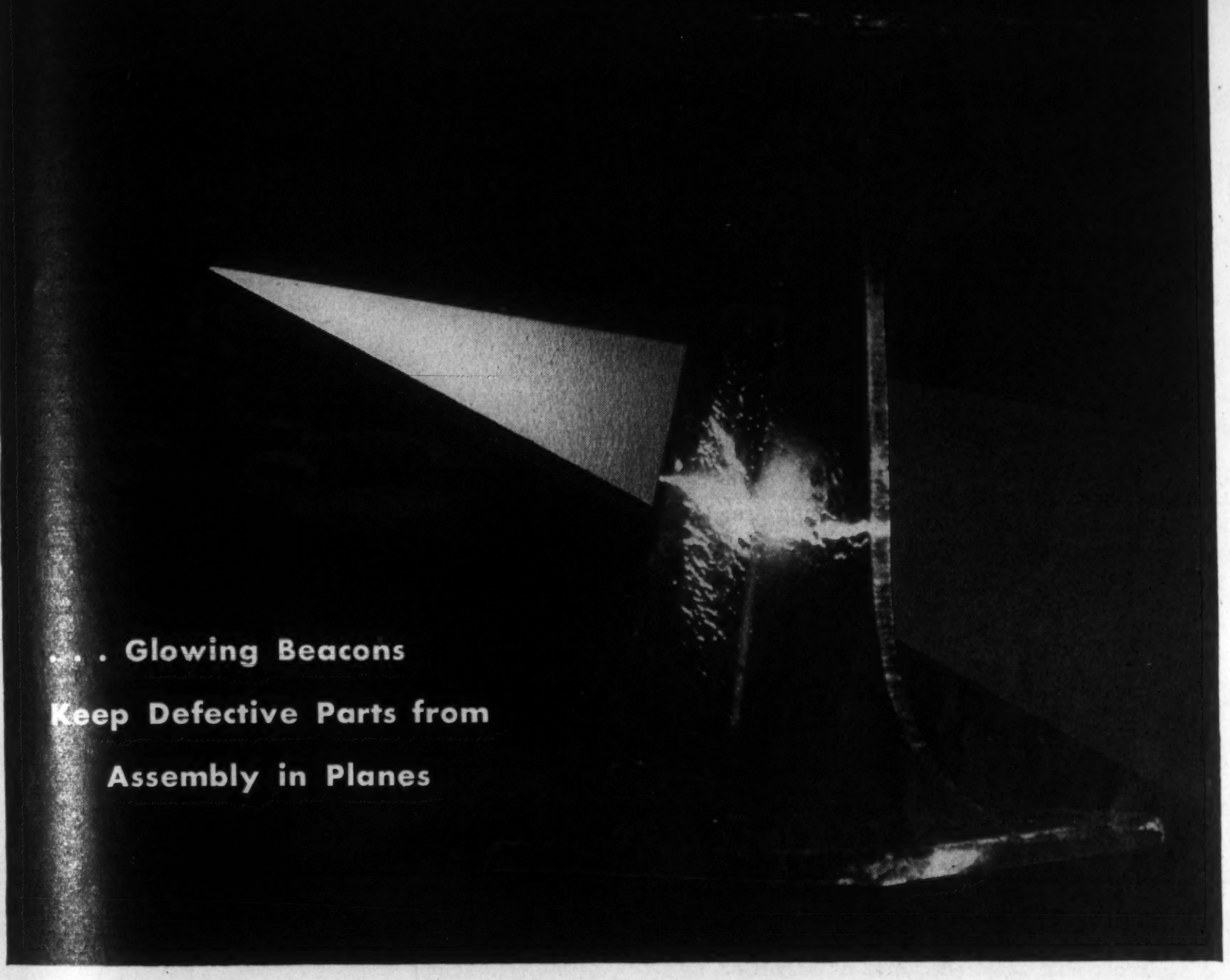
Easing Production Inspection

Condensed from "Western Metals"

Two broad tooling innovations at the plants of Consolidated Vultee Aircraft Corp. have accounted for a saving of 40% in production time through fewer rejected parts, easier assembly and elimination of such bottlenecks as complicated final assembly fixtures and detailed inspection. As the quality of the average worker's prefactory experience decreased, it became necessary for the quality of the tools to increase and for them to be made as nearly foolproof as possible.

One of these two phases was to produce tools for the fabrication of parts to such exactness that inspection of parts before assembly was made practically unnecessary. The other was to provide production in-

INESCAPABLE INDICATIONS



● Weaknesses that threaten to develop in American armaments are discovered at home, in the factory, and not by the enemy shooting down crippled planes over the battlefield. This is a powerfull factor in our military strength.

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The cast aluminum fitting shown here, when inspected under black light by the Magnaflux Corporation's Zyglo Method glowed with fluorescent indications of serious shrinkage cracks. To catch such defects in the foundry before passing them along offers huge savings. Not the least of these is reputation.

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Identometer is a new and valuable tool for metallurgical separation. Stocks can be identified on receipt and stored correctly according to type. Material *should* be checked before expensive machining and processing is begun. Stocks that have been mixed can be quickly and accurately re-sorted.

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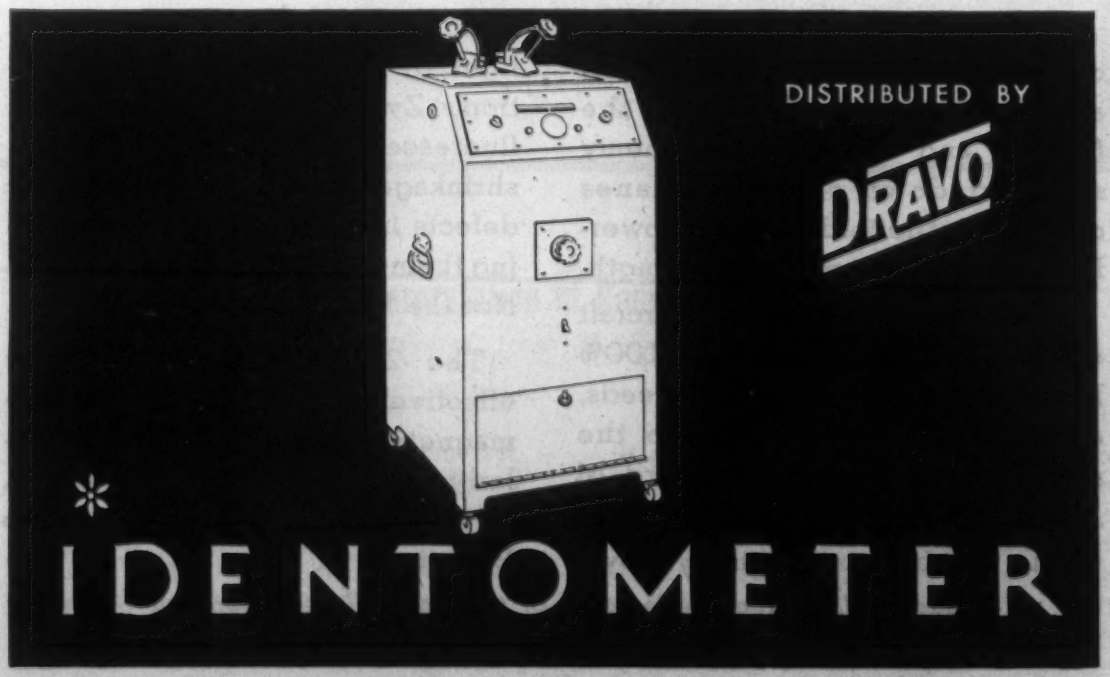


AN ELECTRICAL INSTRUMENT FOR THE INSTANT AND ACCURATE IDENTIFICATION OF MOST ROLLED OR FORGED FERROUS ALLOYS BY THE USE OF REFERENCE SPECIMENS

spection with the necessary tools to simplify hours of elaborate inspection into a few simple mechanical checks, thus minimizing the need of highly skilled production inspection personnel.

Thus, in the manufacture of the B-24 Liberator nacelle assembly line, so completely interchangeable are the parts of this assembly and so accurately have they been made that along the entire length of the assembly line tools other than wrenches and screwdrivers are the exception rather than standard practice.

All fabrication tools stem directly from master tools, which are designed and built by super-skilled tool engineers, designers, makers and inspectors. These masters are tools to which all other manufacturing tools and inspection gages are made or coordinated. They are laid out to very close tolerances and machined with great care. They are kept under lock and key to be used only for checking.

Engineering drawings would give a tolerance of ± 0.010, but the tooling master is held to ± 0.002. Formers and inner rings in the nacelle assemblies are examples. Along the assembly lines it is merely a job of buttoning predrilled cowling sections into predrilled ring and former. No separate assembly fixture is needed to hold the parts in alignment while being drilled. The higher cost of master tools would not be justified in other than super-mass production.

—V. E. Childers. *Western Metals*, Vol 1, Nov., 1943, pp. 58-61.

Toughness of Molding Materials

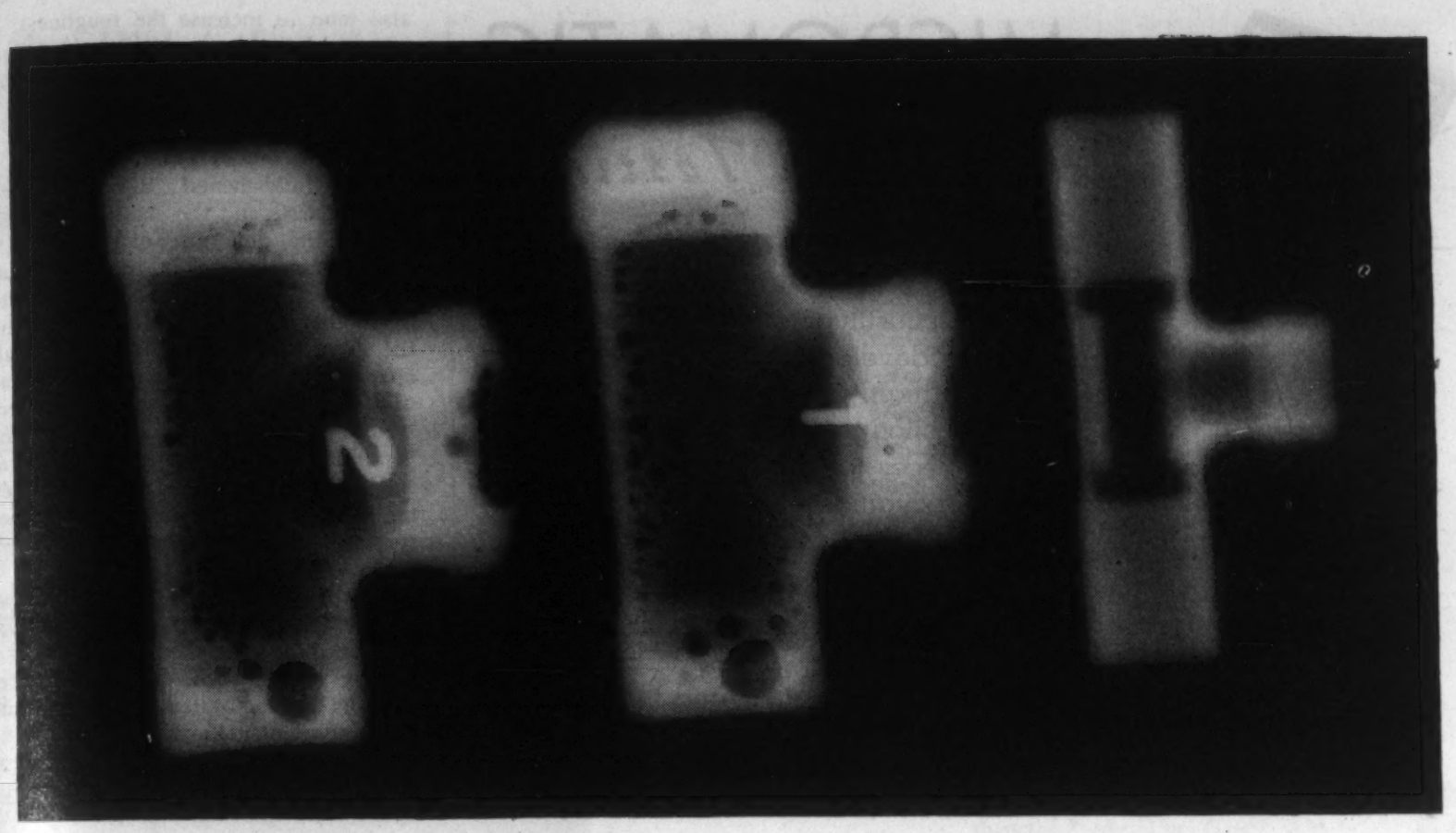
Condensed from "Modern Plastics"

The principal tests to determine the toughness of molding materials are the Charpy and Izod impact strength tests. In addition, there are special tests, both single blow and repeated blow types.

In using the Izod test, numerous inconsistencies are encountered. The toughness of a material, or its ability to absorb energy when deformed under load, is inversely proportional to its modulus of elasticity, whereas this property tends to offset the result of the Izod or Charpy impact test in precisely the reverse manner. The tests have value, but the results must be interpreted with extreme care.

The standard flexural test is an excellent means of approaching the study of the toughness of materials. Such tests show that the great majority of phenolic plastic molding materials show slight, if any, deviation from Hooke's law for all values of applied load up to the breaking point.

In general, for most phenolic molding plastics, attempts to increase the toughness should be aimed primarily at increased ultimate strength characteristics, since the toughness is proportional to the second power of the flexural strength. A lowering of the modulus of elasticity will



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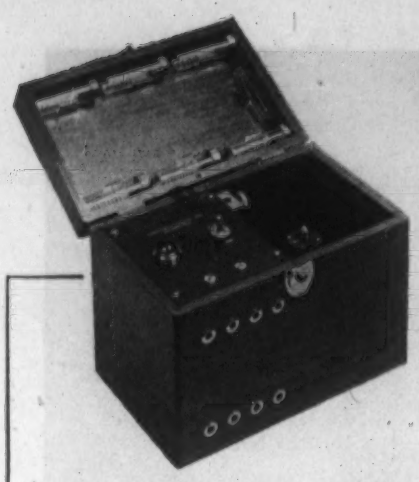

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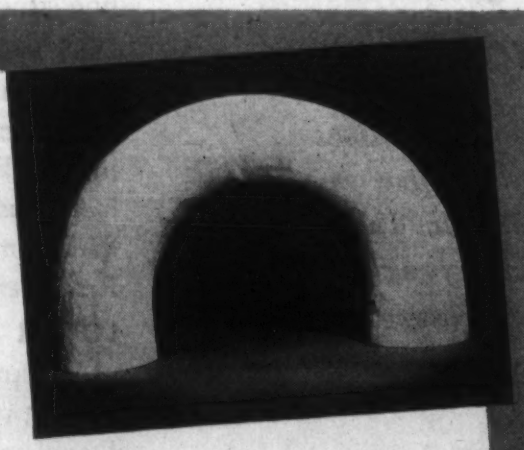

are known for their long successful service in chemical, electrical, metallurgical and other technical applications. They are light in weight, which saves you expensive supporting structures. They are free from metallic impurities, and combine the advantages of the highest temperature shock resistance of any ceramic material with thoroughly effective high-temperature electrical insulation. Pipes and fittings in Vitreosil are specially built to withstand acid reactions at elevated temperatures (pipes can be supplied with closed end for use as pots or muffles), heat treatment of metals, high-vacuum processes, and controlled- atmosphere techniques.

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also tend to increase the toughness, but it is not desirable to reduce it too much as this causes a sacrifice of rigidity in molded parts.

Bending vs. Impact Tests

One fundamental difference between bending tests and the standard impact tests lies in the time rate of loadings, which is a minute or so in the former and a small fraction of a second in the latter.

Another difference is in the nature of the fracture produced. The flexural test must be stopped at the appearance of a fracture. In the impact test, the broken end is usually torn away with consequent expenditure of additional energy. This makes the bending test tend to underrate and the Izod test to overrate the toughness of special high-impact materials with fabric fillers.

Charpy impact tests give high values for low-loss steatite, but the toughness as determined by bending tests is only slightly higher than that of the phenolic low-loss mineral-filled molding material. It is important to emphasize that the toughness of a material is a significant property quite apart from any relationship it may have to the general problem of shock resistance.

Out of a total of 12 specimens tested from a given batch of transparent phenolic resin molding material, flexural strengths ranging from 10,000 to 21,000 p.s.i. were obtained. The material is very tough but difficulties in molding and other factors prevent consistent realization of its strength characteristics.

After-baking treatment given to phenolic mineral-filled heater plug material increases flexural strength and decreases the modulus of elasticity, thus increasing toughness. These static bending tests give this material toughness ratings more nearly in agreement with ordinary experience than do the standard impact tests.

—T. Hazen, *Modern Plastics*, Vol. 21, Oct. 1943, pp. 103-106, 144.

Radiography Aids Steel Casting

Condensed from "Canadian Metals and Metallurgical Industries

The examination of first castings provides for correction of casting practice promptly. Gamma ray radiography provides a non-destructive method of inspection and the assurance of solid castings. Blowholes, shrinks and porosity are shown with unerring exactness.

Many types of castings may be radiographed in a single setup. Important factors in making the setup are: quantity of radium speed of film, distance of radium from film; thickness of metal to be penetrated; and the time of exposure.

While X-ray examination must be made

Q *Which x-ray film is first choice for use with calcium tungstate screens?*

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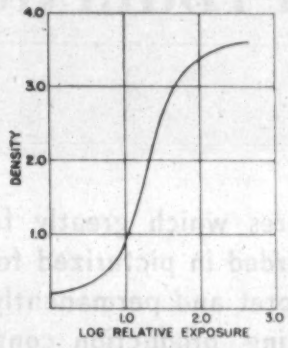
Kodak Industrial X-ray Film, TYPE F, is especially designed for use with calcium tungstate intensifying screens, with which, because of its high sensitivity to the fluorescent light emitted by the screens, it provides the highest available speed and contrast. It is first choice in all work where the intensification of calcium tungstate screens is necessary to reduce exposures to reasonable times—such as in the radiographic examination of thick steel parts. It may also be used with lead-foil screens, with which it provides medium contrast, in either x-ray or gamma-ray exposures.



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. . . "made to order" for higher voltages, light alloys, and critical inspection.

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. . . primarily for light alloys at lower voltages and million-volt radiography of thick steel parts.

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X-ray Division, Rochester 4, N. Y.

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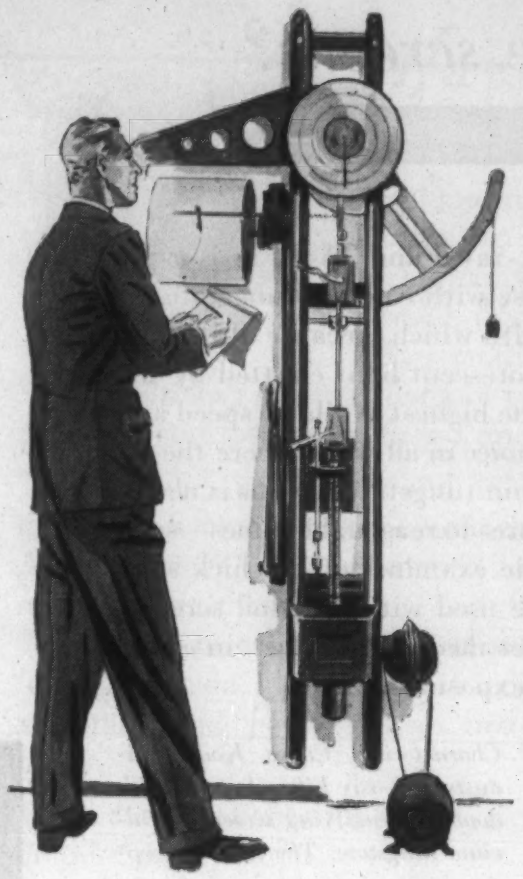

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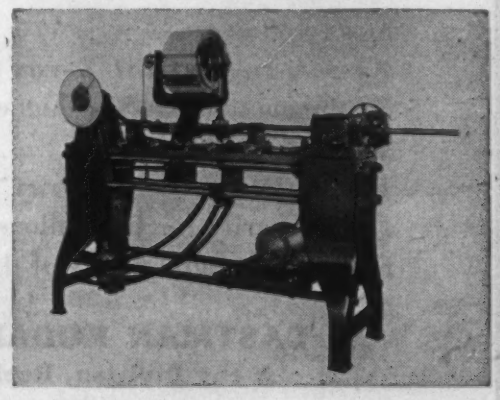

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on completely finished castings, and results may be delayed weeks in being reported, Gamma-ray examination may show within 48 hrs. whether or not the correct foundry technique has been applied. The radiographing of castings in the rough means that only sound castings need be cleaned and heat-treated.

An outstanding advantage of gamma-ray inspection is the exposure of defects in all parts of castings of uneven section on the same exposure. Others are the flexibility of the setup and its mobility. The ability to set up numerous small castings on a single plate cuts film costs to a minimum.

Losses, when production started, were due mostly to shrinks, cracks, blow holes or gas pockets, which, in turn, were caused more or less by the gating and risering technique used at that time. To produce economically, yields must be kept as high as possible, but every type of alloy has its "yield limits." If yields are cut beyond these limits, several types of defects may occur, with shrinks predominating. Each type of casting has its own "yield limit."

Temperature control is vital when pouring castings, large or small, particularly in the case of small heavy castings.

—G. W. McCleary. *Can. Metals & Met. Inds.*, Vol. 6, Nov. 1943, pp. 23-26.

Inspection by Green Light

Condensed from "Electrical News"

The inspection of 20-mm. airplane cannon shell was proving a bottleneck at an arsenal near Toronto. Initially, trays of shells were passed along by hand. The visual inspection was done under 200-watt blue daylight incandescent lamps that gave 50-ft. candles under the units and 5-ft. candles between the units.

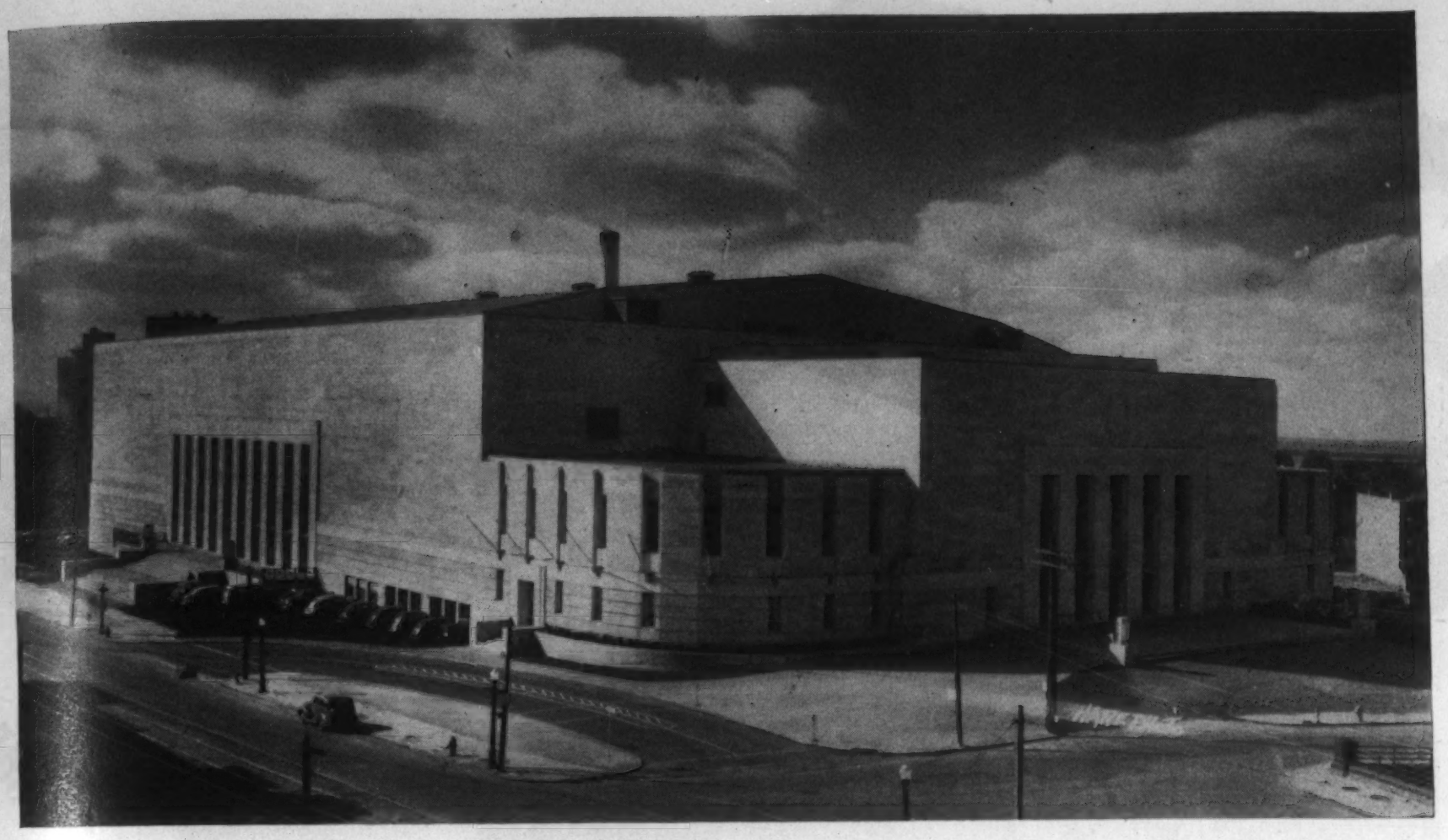
A conveyor belt for transporting the shell gave a considerable but still inadequate increase, in the rate of inspection.

Rust in the bottom of the shell, which would cause a premature explosion, is cause for rejection. Since the shell is 2½ in. deep and ¾ in. in diam. it was difficult to get enough light to the bottom to allow proper inspection.

It was found that green fluorescent light makes the rust spots stand out very clearly; likewise, this light gives off the least amount of heat for a given light intensity. Forty-watt lamps combined with industrial reflectors were arranged to give an even illumination of 200-ft. candles.

The results in increasing the daily number of shell inspected were so satisfactory that two other inspection units have now adopted this type of illumination.

—W. D. Hannah. *Elect. News*, Vol. 52, Nov. 15, 1943, pp. 41-42.



Buffalo Memorial Auditorium

Annual Conclave of American Foundrymen

PRACTICAL INFORMATION and equipment which can be useful and necessary in assisting in the winning of the war will be emphasized and discussed at the annual convention and exhibition of the American Foundrymen's Association to be held in Buffalo N. Y., April 25 to 28. This gathering is designated as the Third War Production Congress. It is also the 48th annual convention of the association. The headquarters is the Hotel Statler.

A very comprehensive program of technical papers, lectures and other discussions has been prepared, a general summary of which is found in the paragraphs that follow.

This year a large exhibition of equipment will be displayed in the Buffalo Memorial Hall. The companies exhibiting have planned to concentrate their efforts on displays of improved and new products which provide maximum value in the wartime production of castings.

The annual business and awards session is scheduled for Thursday morning, April 27.

The annual dinner brings the week's conclave to a close Friday evening, April 28.

The Technical Programs

A comprehensive and ambitious technical program has been prepared which is spread over some 45 sessions and lectures, covering practically every field in the foundry industry, and these are many.

The technical sessions will start on Tuesday, April 25, and continue,, morning, afternoon and evening, through Friday, April 28. In many cases, two or three simultaneous sessions are scheduled.

First Foundation Lecture

One of the highlights of the technical feast will be the first A.F.A. Foundation lecture to be presented on Thursday morning, April 27, following the annual business and awards meeting, by Dr. H. W. Gillett, chief technical adviser of Battelle Memorial Institute, Columbus, Ohio. His subject will be "Cupola Raw Materials."

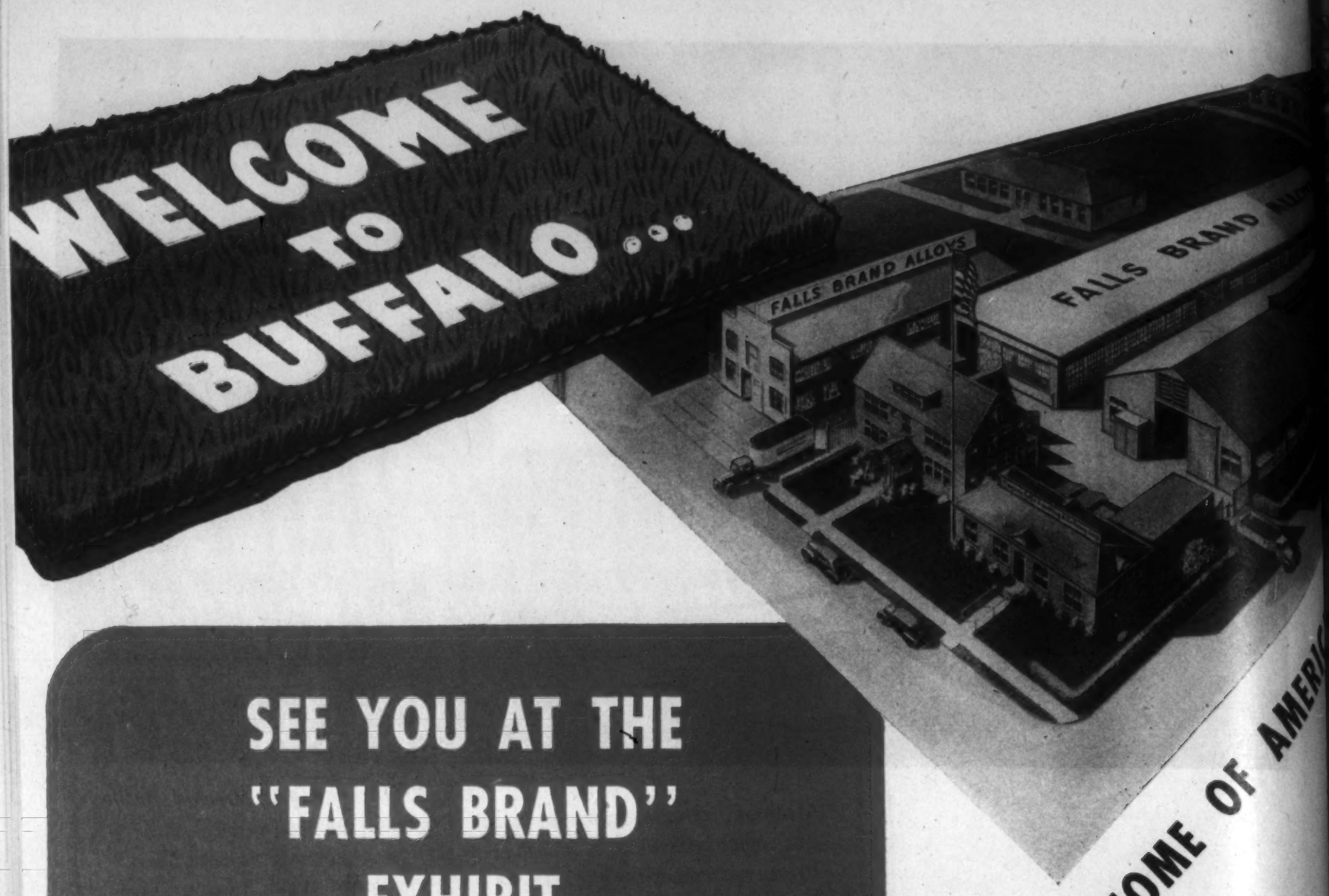
Some of the subjects of the various technical sessions include: Aluminum and Magnesium, Malleable Iron, Refractories, Plant and Plant Equipment, Brass and Bronze, Gray Iron Castings, Foundry Sand Developments, Gray Iron Shop Course, Sand Shop Course, Engineers in the Foundry, Steel Castings, Centrifugal Castings, and Pattern Making. A condensed preview of some of these sessions follows.

The Technical Sessions

Aluminum and Magnesium: Three sessions have been allotted to this branch of the industry, the afternoons of April 25, 26, and 27. A broad field is covered which includes papers on the effect of alloying elements; the cold chamber die casting process; measuring relative permeability in dense mold materials; the mechanized production of gravity die castings (official exchange paper of the Institute of British Foundrymen); micro-radiography as a foundry tool; and need for better quality aircraft castings.

Malleable Iron Castings: Two sessions are devoted to a symposium on malleable iron to be held on Tuesday afternoon and Wednesday morning, April 25 and 26. Another session on malleable founding is set for the afternoon of April 26. Some of the subjects for the symposium include gating and risering, pattern planning, gating and heading and gating and feeding. For the third session discussion

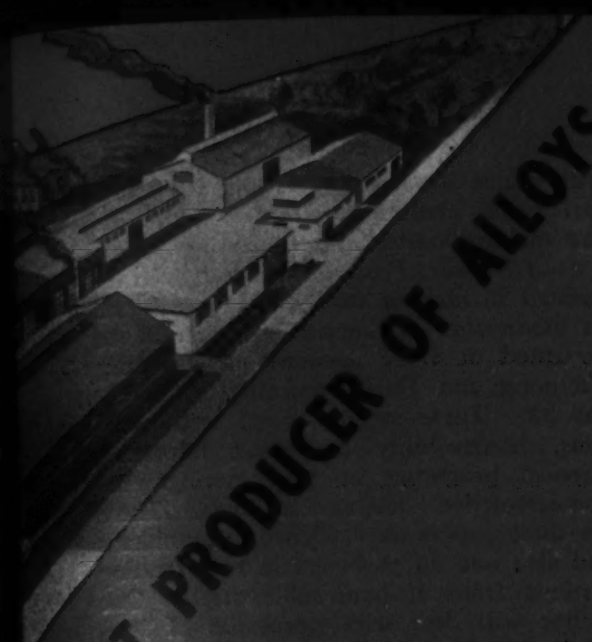
(Continued on page 998)



SEE YOU AT THE "FALLS BRAND" EXHIBIT WAR FOUNDRY CONGRESS

Yes, we're dusting off the welcome mat and hanging out the latch-string for you foundrymen who will make Buffalo the capitol of the foundry world from April 25-28.

Many members of our staff will be in the booth to discuss with you the latest things in alloys and metallurgical procedure. If you have a problem discuss it with us. We can probably help you solve it as we have thousands of others.



LARGEST PRODUCER OF ALLOYS

ALUMINUM ALLOYS

FLUXING ALLOYS

HARDENERS

INTERMEDIATE ALLOYS

SPECIAL ALLOYS

BRONZE INGOTS

FLUXES

Niagara Falls Smelting & Refining Corporation

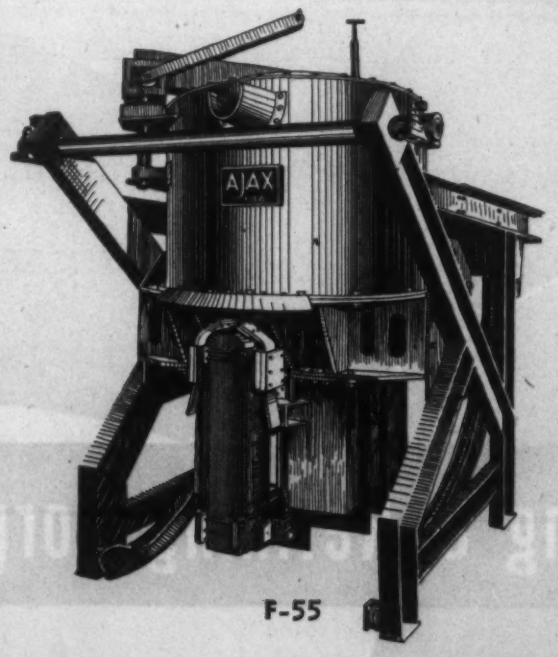
BUFFALO 17,
NEW YORK

PLANTS NOW MELTING ALUMINUM ALLOYS ELECTRICALLY ENJOY THESE SPECIFIC ADVANTAGES...

1. **VASTLY INCREASED PHYSICALS** (tensile strength and elongation) in foundry, die-cast, or rolling mill products.
2. **DECREASED GAS ABSORPTION AND SEGREGATIONS** hitherfo due to conventional melting practice.
3. **CLEAN-CUT, ACCURATE TEMPERATURE CONTROL** during the melting and pouring stages.
4. **GREAT EASE AND SIMPLICITY IN HANDLING ALLOYS** that were once considered sensitive and difficult to melt.
5. **ELIMINATION** of oxide inclusions.
6. **COOL AND CLEAN** foundry operations.
7. **DELIVERY** of the rated production per hour on the hour, (production capacity 300 lbs. to 1250 lbs. per hour).

This is the first commercial electric furnace for melting aluminum alloys in continuous operation. It utilizes the famous Ajax-Wyatt low-frequency induction melting principle which has been applied successfully for nearly all wrought brass melted throughout the world.

Write for new bulletins . . .
(The "TW" Group)



F-55

AJAX ENGINEERING CORPORATION, Box 1418, Trenton 7, N. J.

THE AJAX TAMA-WYATT INDUCTION MELTING FURNACE

ASSOCIATE COMPANIES:
AJAX METAL COMPANY, Non-Ferrous Ingot Metals and Alloys for Foundry Use
AJAX ELECTROTHERMIC CORP., Ajax-Northrup High Frequency Induction Furnaces
AJAX ELECTRIC CO., INC., The Ajax-Hultgren Electric Salt Bath Furnace
AJAX ELECTRIC FURNACE CORP., Ajax-Wyatt Induction Furnaces for Melting

will center around papers on pulverized coal firing, malleable mixture calculation and melting control, coin pressing, etc.

Steel Foundry Problems: Foundrymen interested in making steel castings will find an assortment of important topics to be presented at three sessions on Thursday afternoon and Friday morning, April 27 and 28. These include: Steel sand problems, hardenability and heat treatment, physical properties of steel castings and non-destructive testing methods. There are three papers on hardenability problems and also one on problems in heat treating castings from air-hardenable steel. One author will deal with properties of low-alloy, low-copper-bearing steels and another with recent steel casting developments.

Gray Iron Castings: Three sessions are devoted to gray iron, two on Wednesday morning and afternoon and one on Thursday afternoon, April 25 and 26. Among the papers to be presented may be mentioned those on molding gray iron cylinders, a study of molding methods for sound castings, cupola operation, engineering properties of gray cast iron and method of preparing gray iron for subsequent processing.

Gray Iron Shop Course: This is always an important feature at annual conventions. This year four sessions are allotted to this, three during the evenings of Tuesday, Wednesday and Thursday and the last one Friday afternoon.

Sand Shop Courses: For this important topic three sessions are scheduled during the evenings of Tuesday, Wednesday and Thursday.

Centrifugal Castings: A symposium of two sessions has been arranged presenting seven papers. These deal not only with problems and methods of production but also with the engineering principles involved in various phases of the construction of centrifugal casting machines. These sessions are to be held during the late afternoon of Thursday and Friday, April 27 and 28.

Other Sessions: Some of the meetings devoted to other subjects include: Plant and Equipment, Solidification and Heat Transfer, Analytical Methods for Cast Metals, Foreman Training, Inspection of Castings, Engineers in the Foundry, Safety and Hygiene, and Job Evaluation and Time Study.

Lectures

Besides the first AFA Foundation lecture to be delivered Thursday morning after the annual business meeting by Dr. H. W. Gillett, already referred to, there will be a 4-course series of lectures on heading and gating. The first three are scheduled for 4 p.m. on Tuesday, Wednesday and Thursday with the fourth on Friday morning, April 28. The subjects for each lecture are gray iron, steel, aluminum and magnesium, and brass and bronze, led by representative authorities in each field.

Luncheons

The usual number of special luncheons are to be held. The malleable round table luncheon on Wednesday, April 26, will be presided over and led by J. H. Lansing, A. M. Fulton and K. H. Hamblin.

Fifty years ago The Carborundum Company introduced the first grinding wheel of a manufactured abrasive to the foundry trade

WE have come a long way since then—a long way in grinding wheel development—in the technique of grinding wheel manufacture.

Carborundum research through all these years has resulted in new types of abrasive grain, continuously improved bonding materials—an unprecedented advancement in the creation of wheel structures—plus the development of high speed resinoid bond wheels.

This progress is reflected in longer wheel life, faster and greater stock removal—a definite lowering of foundry grinding costs.

And it is a progress that is still going on, for Carborundum research, of course, never stands still.

Wise grinding procedure dictates that you make certain you are using the right wheel for a given job—right grit, grade and structure, the right type of abrasive. The use of the wrong wheel usually means loss of production, excessive wheel wear and excessive wheel and grinding costs.

Remember, please, that Carborundum Abrasive Engineering Service is maintained to help you get the most and the best out of your grinding wheels. It will pay you to take advantage of the knowledge and experience that is back of this service.

Grinding wheels are weapons for production—use them wisely and well. The Carborundum Company, Niagara Falls, New York.

* * *

Sales Offices and Warehouses in New York, Chicago, Philadelphia, Detroit, Cleveland, Boston, Pittsburgh, Cincinnati, Grand Rapids.

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TRADE MARK
ABRASIVE PRODUCTS

(Carborundum is a registered trade mark of and indicates manufacture by The Carborundum Company)

by CARBORUNDUM
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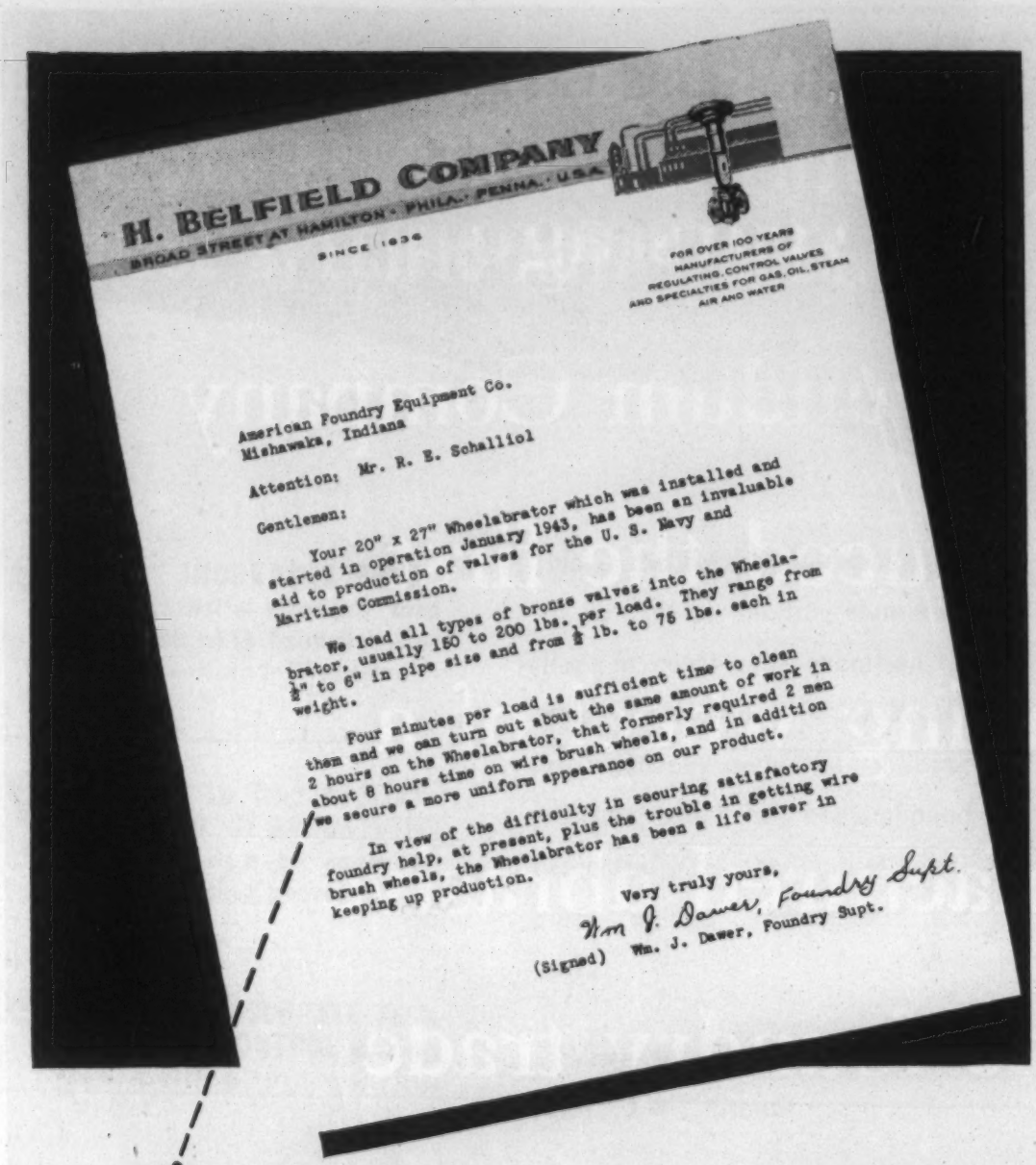

H. BELFIELD COMPANY
BROAD STREET AT HAMILTON · PHILA., PENNA., U.S.A.
SINCE 1836
FOR OVER 100 YEARS MANUFACTURERS OF REGULATING, CONTROL VALVES AND SPECIALTIES FOR GAS, OIL, STEAM AIR AND WATER

American Foundry Equipment Co.
Mishawaka, Indiana

Attention: Mr. R. E. Schalliol

Gentlemen:

Your 20" x 27" Wheelabrator which was installed and started in operation January 1943, has been an invaluable aid to production of valves for the U. S. Navy and Maritime Commission.

We load all types of bronze valves into the Wheelabrator, usually 150 to 200 lbs. per load. They range from ¾" to 6" in pipe size and from ¼ lb. to 75 lbs. each in weight.

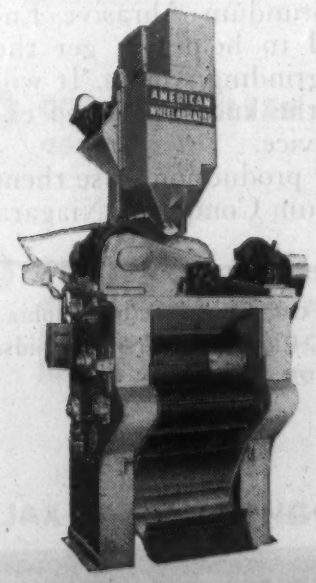
Four minutes per load is sufficient time to clean them and we can turn out about the same amount of work in 2 hours on the Wheelabrator, that formerly required 2 men about 8 hours time on wire brush wheels, and in addition we secure a more uniform appearance on our product.

In view of the difficulty in securing satisfactory foundry help, at present, plus the trouble in getting wire brush wheels, the Wheelabrator has been a life saver in keeping up production.

Very truly yours,
Wm J. Dawer, Foundry Supt.
(Signed) Wm. J. Dawer, Foundry Supt.

* final cost ...IS THE PAYOFF ... IN METAL CLEANING

Today the emphasis is on all out production at any cost. Proof that the American Airless Wheelabrator speeds production comes from countless satisfied users like the statement in the letter above, "invaluable aid to production of valves for the U. S. Navy and Maritime Commission."



Tomorrow it will be different! In the post-war world the keynote will be: cost based on efficiency of operation. Proof of the efficiency of Wheelabrator is evident in the above letter as stated, "we can turn out about the same amount of work in 2 hours on the Wheelabrator that formerly required 2 men about 8 hours . . . and in addition we secure a more uniform appearance on our product."

Every day Wheelabrator is giving faster, better production with less cost and a minimum of maintenance. Why not arrange for a demonstration to see for yourself how your products may be cleaned better by Wheelabrating? The world's largest builders of Airless Blast Equipment show record results in final cost . . . and that is the payoff in metal cleaning.

*** Write for further information.**

American
FOUNDRY EQUIPMENT CO.
509 SOUTH BYRKIT STREET • MISHAWAKA, INDIANA

The round table luncheon of the brass and bronze people is scheduled for Thursday, April 27 — the subject will be exclusively brass and bronze melting and an extremely interesting set of 5 papers has been arranged.

The steel division round table luncheon will take place Friday. It will consist of a "general discussion," led by such representative steel foundrymen as John Howe Hall, G. A. Lillieqvist, and A. H. Jameson.

Other luncheons include the ones by the castings inspection committee, apprentice training, the executive committee of the pattern division and one for Canadian members of the association.

Dinners

The annual banquet is to be held Friday evening, April 28, the last day of the convention. Other dinners include the chapter officers dinner and one for the foundry instructors.

Opening Session

The formal opening of the Third War Production Congress is scheduled for 10 a.m., Tuesday, April 25. The president's annual address will be delivered by the outgoing president, L. C. Wilson, followed by an address by Rear Admiral A. H. Van Keuren, Naval Research Laboratories, Washington.

Following this there will be a War Production Manpower Session to be addressed by H. S. Colby, consultant to the deputy Vice Chairman for Production, WPB, Washington.

Business Meeting and Awards

The annual business and awards meeting will be held Thursday morning, April 27, with President Wilson in the chair. The reports of officers will be followed by the election of new officers.

The annual bestowal of awards will include the Joseph S. Seaman Medal of the A. F. A., which is this year awarded to William G. Reichert, president of the W. G. Reichert Engineering Co., Newark, N. J. "in recognition of his outstanding service to the Foundry Industry and the Association, especially for his work in the educational and research fields of Foundry Sand and its control."

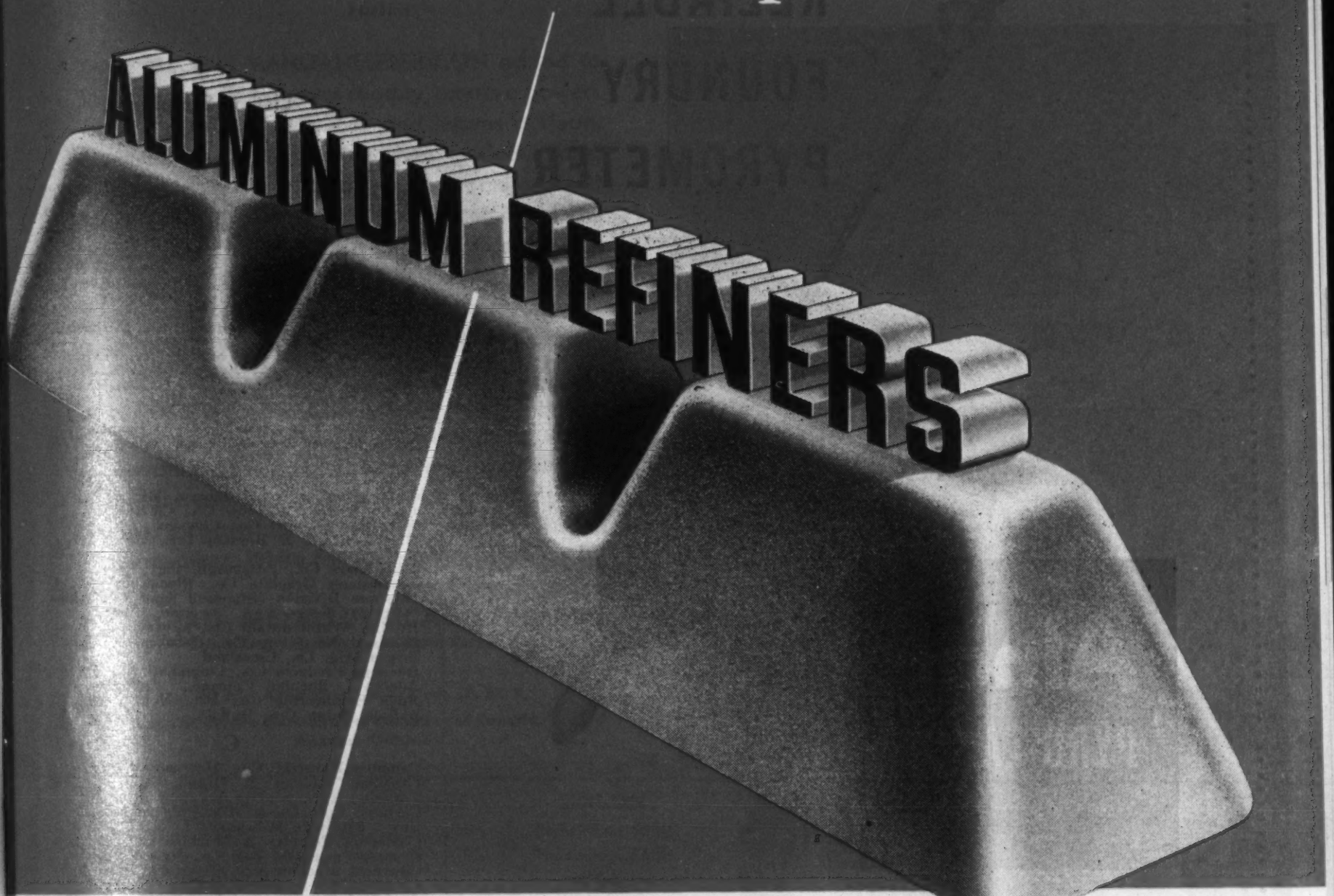
To Alfred W. Gregg, executive engineer, Whiting Corp., Harvey, Ill., will go the J. H. Whiting Gold Medal of the A.F.A. "in recognition of his outstanding contributions to the Foundry Industry and the Association, especially for his work in the development of Steel Melting Practices."

Two Life Membership awards will be bestowed on Herman E. Alex of the Davenport Machine & Foundry Co., Davenport, Iowa, and to John Hill, president of Hill and Griffith Co., Cincinnati, Ohio — both for their long and continued interest in the Association.

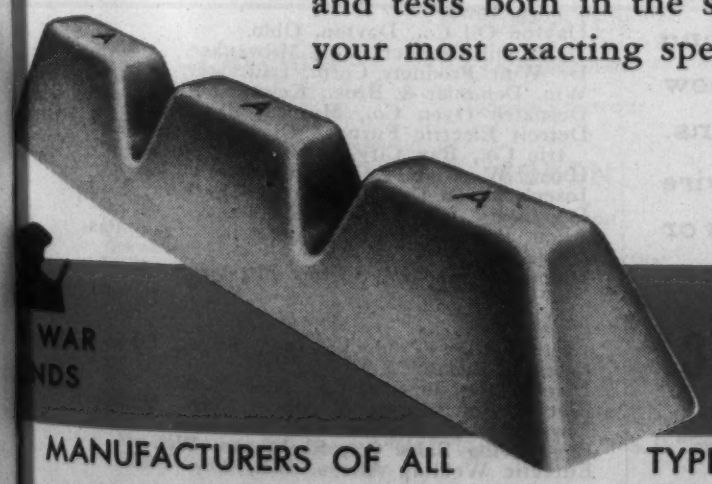
The Foundry Exhibition

Last year at the 47th annual convention or Second War Production Congress in St. Louis, no exhibition of foundry equipment or products was held. These are usually held no oftener than every other year.

Aluminum Alloy Ingot of Uniform Composition



AS YOU well know, uniformity in composition of aluminum alloy ingot is a mighty important thing from your standpoint. Ingot that exactly meets your specifications—that is free from all impurities—smooths the way for the making of perfect castings. It keeps down production costs—increases profit. That is exactly the kind of alloy ingot you get from Aluminum Refiners. Checks and tests both in the smelting room and in the laboratory assure that your most exacting specifications are met—exactly on the nose!



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BOHN ALUMINUM & BRASS CORPORATION · Detroit, Michigan

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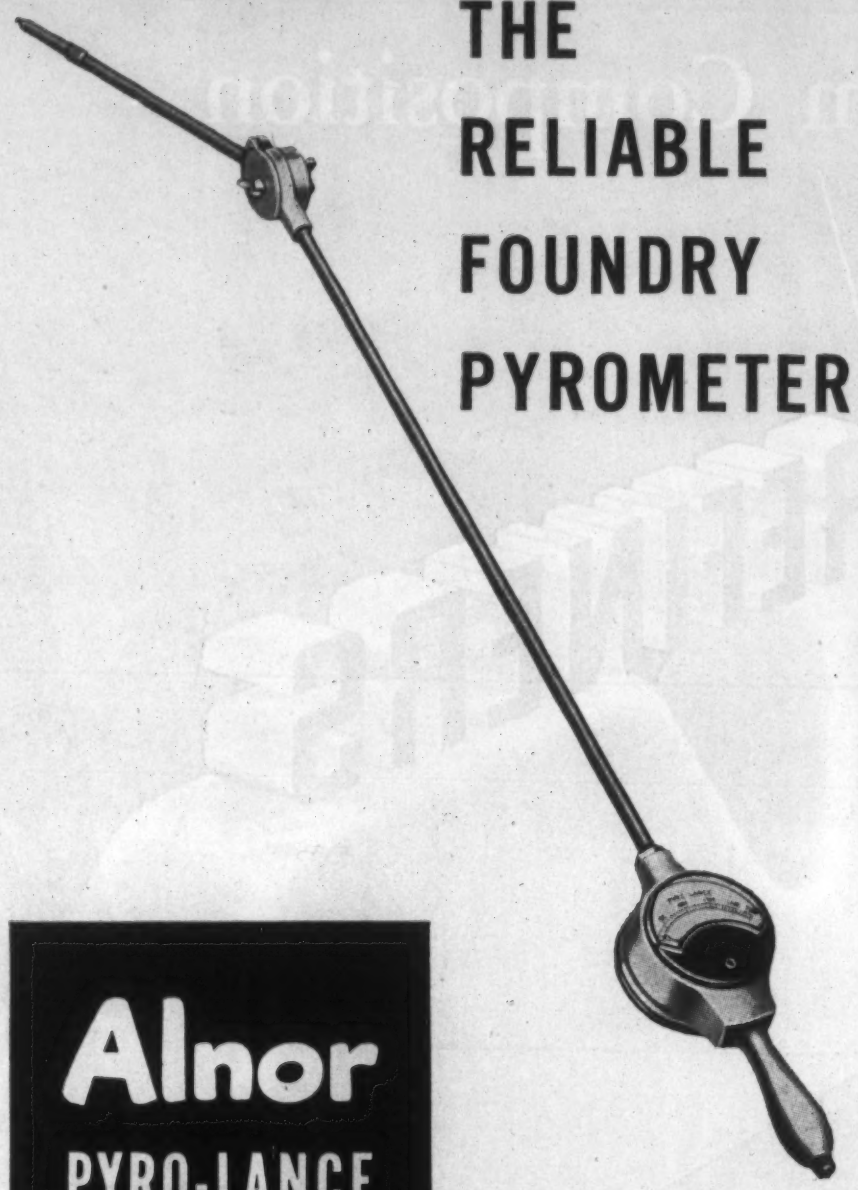
MANUFACTURERS OF ALL TYPES AND SHAPES OF CASTING AND DEOXIDIZING ALLOYS

THE RELIABLE FOUNDRY PYROMETER



Alnor
PYRO-LANCE

The Alnor portable Pyro-Lance is a rugged, durable, portable pyrometer built with shock-resisting movement and enclosed extension thermocouple. It stands up in foundry service and gives the accurate temperature readings essential to low-cost production of sound castings. Especially suited for use on molten brass, bronze, copper, aluminum bronze, magnesium alloys, and similar metals where temperatures are not over 2300° F. Long life, enclosed thermocouple takes true readings below the surface, unaffected by dross or surface conditions.

Built in standard range, 0-2500° F. Also with bare wire thermocouple for low temperature metals in crucibles or ladles. Write for bulletins giving complete description.

ILLINOIS TESTING LABORATORIES, INC.
420 North La Salle Street
Chicago 10, Illinois

This year a fairly large exhibition has been arranged which promises to be exceedingly interesting and valuable in promoting the war effort. The display is to be held in the Buffalo Memorial Hall. It will be open as a preview Tuesday evening, April 24, and then each day after that through Friday, April 28.

Over 225 exhibitors have engaged space for this exposition. A partial list of them follows:

List of Exhibitors

A

Adams Co., Dubuque, Iowa.
Air Reduction Sales Co., New York.
Ajax Electrothermic Corp., Trenton, N. J.
Ajax Engineering Corp., Philadelphia.
Ajax Metal Co., Philadelphia.
Ajax Flexible Coupling Co., Westfield, N. Y.
American Air Filter Co., Inc., Louisville, Ky.
American Allsafe Co., Inc., Buffalo.
American Crucible Co., Shelton, Conn.
American Foundry Equipment Co., Mishawaka, Ind.
American Optical Co., Southbridge, Mass.
American Photocopy Equipment Co., Chicago.
American Steel Abrasive Co., Galion, Ohio.
Arcade Mfg. Co., Freeport, Ill.
Asbury Graphite Mills, Inc., Asbury, N. J.
Automatic Transportation Co., Chicago.
Ayers Mineral Co., Zanesville, Ohio.

B

Baker Perkins, Inc., Saginaw, Mich.
C. O. Bartlett & Snow Co., Cleveland.
Beardsley & Piper Co., Chicago.
Black, Sivalls & Bryson, Inc., Kansas City, Mo.
Blaw-Knox Co., Pittsburgh, Pa.
Bloomsbury Graphite Co., Bloomsbury, N. J.
Blystone Division (Standard Sand & Machine Co.), Chicago.
Bradley Washfountain Co., Milwaukee.
Brickseal Refractory Co., Hoboken, N. J.
Briggs Mfg. Co., Cleveland
Buckeye Products Co., Cincinnati.
Adolph I. Buehler, Chicago.
Buell Engineering Co., Inc., New York.
Buffalo Forge Co., Buffalo.

C

Campbell-Hausfeld Co., Harrison, Ohio.
Canadian Radium & Uranium Corp., New York.
Certified Core Oil & Mfg. Co., Cicero, Ill.
Chain Belt Co., Milwaukee.
Champion Foundry & Machine Co., Chicago.
Chicago Pneumatic Tool Co., New York.
Clearfield Machine Co., Clearfield, Pa.
Cleveland Pneumatic Tool Co., Cleveland.
Cleveland Quarries Co., Cleveland.
Climax Molybdenum Co., New York.
L. A. Cohn & Bro., Inc., Chicago.
L. S. Cohen & Co., Inc., Chicago.
Columbus McKinnon Chain Corp., Tonawanda, N. Y.
Combined Supply & Equipment Co., Inc., Buffalo.
Conco Eng. Works, Div. H. D. Conkey & Co., Mendota, Ill.
Conover Engineering Co., Cleveland.
Corn Products Sales Co., New York.

D

Daily Metal Reporter, Atlas Publishing Co., New York.
Davenport Machine and Foundry Co., Davenport, Iowa.
Dayton Oil Co., Dayton, Ohio.
Delta Oil Products Co., Milwaukee.
De Walt Products Corp., Lancaster, Pa.
Wm. Demmler & Bros., Kewanee, Ill.
Despatch Oven Co., Minneapolis.
Detroit Electric Furnace Div., Kuhlman Electric Co., Bay City, Mich.
Harry W. Dietert Co., Detroit.
Joseph Dixon Crucible Co., Jersey City, N. J.
Dougherty Lumber Co., Cleveland.
Allen B. Du Mont Laboratories, Inc., Passaic, N. J.
Duquesne Smelting Corp., Pittsburgh, Pa.

E

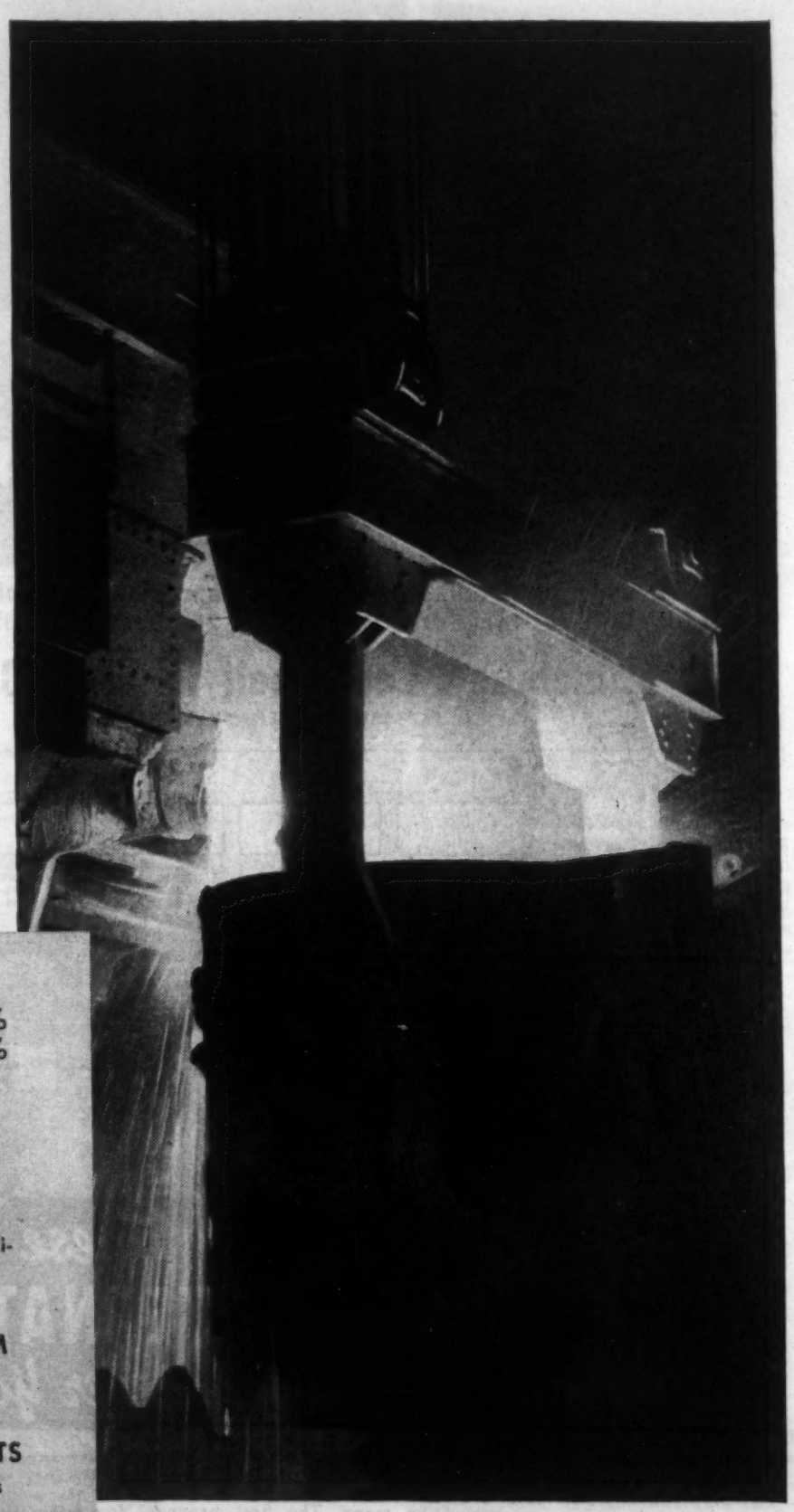
Eastern Clay Products, Inc., Eifort, Ohio.
Eastman Kodak Co.
Electro Metallurgical Co., New York.
Electro Refractories & Alloys Corp., Buffalo.
Elwell-Parker Electric Co., Cleveland.
Engineering Sales Co., Sheboygan, Wis.
Eutectic Welding Alloys, Inc., New York.

Calcium-Manganese-Silicon

—a better Ladle Deoxidizer

CALCIUM-MANGANESE-SILICON added to the ladle dissolves readily, exerts a powerful deoxidizing influence and leaves a clean, sound steel. This alloy, when added alone, promotes the formation of a coarse-grained structure, as determined by the McQuaid-Ehn Test, but when added in combination with aluminum, intensifies the grain-refining influence of the latter metal. A good recovery of manganese and silicon is obtained when Calcium-Manganese-Silicon is used.

Electromet can supply you with Calcium-Manganese-Silicon and assist you to use it advantageously. Electromet metallurgists will gladly call and help you with specific problems regarding the use of any Electromet ferro-alloy. Write for further information.



ELECTRO METALLURGICAL COMPANY
Unit of Union Carbide and Carbon Corporation
UCC
30 East 42nd Street, New York 17, N. Y.
In Canada: Electro Metallurgical Company of Canada, Limited, Welland, Ontario

CHROMIUM
Low-Carbon Ferrochrome (in grades, maximum 0.06% to maximum 2.00% carbon)
High-Carbon Ferrochrome
Nitrogen-Bearing Ferrochrome
S. M. Ferrochrome
Chromium Metal
Chromium-Copper
Miscellaneous Chromium Alloys

CALCIUM
Calcium-Silicon
Calcium-Manganese-Silicon
Calcium Metal

COLUMBIUM
Ferrocolumbium

MANGANESE
Standard Ferromanganese 78 to 82%
Low-Carbon Ferromanganese
Medium-Carbon Ferromanganese
Manganese Metal
Miscellaneous Manganese Alloys

SILICO-MANGANESE

TUNGSTEN
Ferrotungsten
Tungsten Powder

BORON
Ferroboron
Manganese-Boron
SILVAZ Alloy 3
SILCAZ Alloy 3

SILICON
Ferrosilicon 50%
Ferrosilicon 75%
Ferrosilicon 80 to 90%
Ferrosilicon 90 to 95%
Silicon Metal
SMZ Alloy
Miscellaneous Silicon Alloys

VANADIUM
All Grades

EM BRIQUETS
Silicon Briquets
Silicomanganese Briquets
Chromium Briquets

ZIRCONIUM
Zirconium 12 to 15%
Zirconium 35 to 40%

MISCELLANEOUS ALLOYS AND METALS

Electromet
Trade-Mark
Ferro-Alloys & Metals

BUY UNITED STATES BONDS AND STAMPS

The trade-marks "Electromet," "EM," "Silcaz," "Silvaz," "S. M." and "SMZ" distinguish products of Electro Metallurgical Company.

MOORE RAPID

Lectromelt FURNACES

Lectromelts are available in both top charge and door charge types.
Sizes range from 100 tons to 25 pounds capacity.

Pittsburgh Lectromelt Furnace Corp.

PITTSBURGH, PENNSYLVANIA

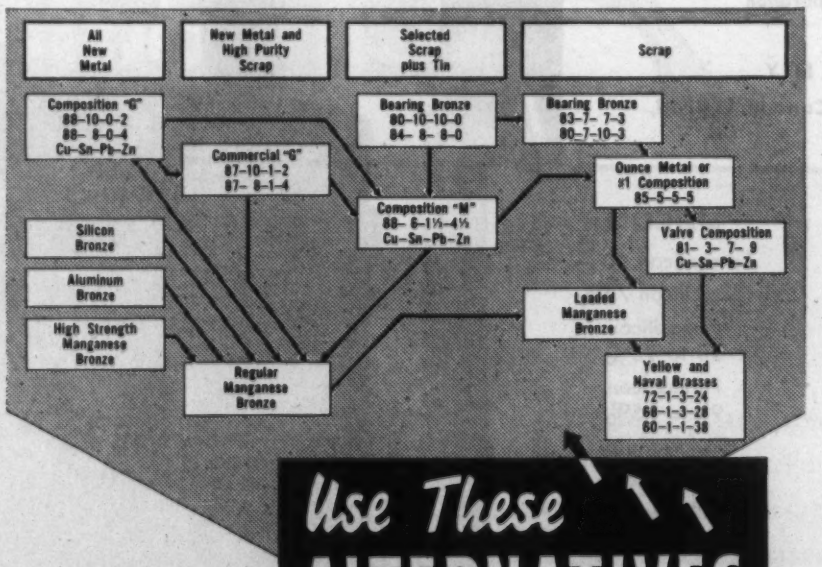
NOTE

"Proper Melting Decreases Foundry Losses," contains interesting data. Also, the booklet, "Nonferrous Ingot Metals of Today." Write for both of these. They are free.

Send for booklet
"INGOT METALS OF TODAY"

16 STANDARD INGOT METALS BY AJAX

Ajax Tombasil
Ajax Plastic Bronze
Ajax Anti-Acid Bronze
Ajax Phosphor Bronze
Ajax Red Brass Ingots
Ajax Manganese Bronze
Ajax High-Tensile Manganese Bronze
Ajax Golden Glow Yellow Brass
Ajax-Hamilton Gear Bronze
Ajax Nickel-Copper 50-50%
Ajax Manganese Copper
Ajax Aluminum Alloys
Ajax Phosphor Copper
Ajax Silicon Copper
Ajax Nickel Alloys
Ajax Phosphor Tin



Use These **ALTERNATIVES** *Wherever You Can*

Notice how the arrows on the W.P.B. chart point to the *right*. . . . They show how alternative materials *currently available* can be utilized by foundrymen as now permitted by many designers. The purpose is to conserve primary metal at the mine through increased use of secondary ingots. Sometimes great ingenuity is called for, yet remember this:

The first program for scientific control of ingot metal was set up by Ajax 46 years ago. The result has been metal and practical technical follow-through in which Ajax increases your production by reducing rejects.

THE **AJAX METAL COMPANY**
ESTABLISHED 1880 **PHILADELPHIA**

ASSOCIATE COMPANIES:
AJAX ELECTRIC FURNACE CORP. Ajax-Wyatt Induction Furnaces for Melting
AJAX ELECTROTHERMIC CORP. Ajax-Northrup High Frequency Induction Furnaces
AJAX ELECTRIC CO., INC. The Ajax-Hultgren Electric Salt Bath Furnace
AJAX ENGINEERING CORP. Ajax-Tama-Wyatt Aluminum Melting Induction Furnaces

F

Federal Foundry Supply Co., Cleveland.
Federated Metals Div., American Smelting & Refining Co., New York.
Fisher Furnace Co., Chicago.
Foundry Equipment Co., Cleveland.
Fox Grinders, Inc., Pittsburgh.
Foxboro Co., Foxboro, Mass.
Freeman Supply Co., Toledo.
Fremont Flask Co., Fremont, Ohio.
Frontier Bronze Corp., Niagara Falls, N. Y.

G

Gamma Instrument Co., Inc., New York.
General Electric X-Ray Corp., Chicago.
Globe Steel Abrasive Co., Mansfield, Ohio.
Great Lakes Foundry Sand Co., Detroit.
Great Western Mfg. Co., Leavenworth, Kan.
Samuel Greenfield Co., Inc., Buffalo.

H

Hanna Furnace Corp., Detroit.
Benjamin Harris & Co., Chicago.
Hercules Powder Co., Wilmington, Del.
Herman Pneumatic Machine Co., Pittsburgh, Pa.
Hickman, Williams & Co., Chicago.
Hill & Griffith Co., Cincinnati.
Hines Flask Co., Cleveland.
Hoffman Foundry Supply Co., Cleveland.
E. F. Houghton & Co., Philadelphia.
Hougland & Hardy, Inc., Evansville, Ind.
Hudson Foundry & Machine Co., Inc., Chicago.
Hydro-Blast Corp., Chicago.

I

Illinois Clay Products Co., Joliet, Ill.
Illinois Testing Laboratories, Inc., Chicago.
Independent Pneumatic Tool Co., Chicago.
Industrial Minerals Co., Lancaster, Ohio.
Ingersoll-Rand Co., Phillipsburg, N. J.
Insto-Gas Corp., Detroit.
International Graphite & Electrode Corp., St. Marys, Pa.
International Molding Machine Co., Chicago.
International Nickel Co., Inc., New York.
Ironton Fire Brick Co., Ironton, Ohio.

J

Jackson & Church Co., Saginaw, Mich.
Jeffrey Mfg. Co., Columbus, Ohio.
Johnston & Jennings Co., Cleveland.

K

Kindt-Collins Co., Cleveland.
Kolene Corp., Detroit.
H. Kramer & Co., Chicago.

L

Lancaster Iron Works, Inc., Lancaster, Pa.
Lava Crucible Co. of Pittsburgh, Pittsburgh, Pa.
R. Lavin & Sons, Inc., Chicago.
Lift Trucks, Inc., Cincinnati.
Link-Belt Co., Chicago.

M

J. S. McCormick Co., Pittsburgh, Pa.
Macleod Co., Cincinnati.
Paul Machlor Co., Chicago.
Magnaflux Corp., Chicago.
R. C. Mahon Co., Detroit.
Mahr Mfg. Co., Div. Diamond Iron Works, Inc., Minneapolis.
Mall Tool Co., Chicago.
Marathon Chemical Co., Div. Marathon Paper Mills Co., Rothschild, Wis.
Mathews Conveyer Co., Ellwood City, Pa.
Master Tool Co., Cleveland.
Metals and Alloys, Reinhold Publishing Corp., New York.
Metallizing Co. of America, Chicago.
Michigan Smelting & Refining Div., Bohn Aluminum & Brass Corp., Detroit.
Mid-West Abrasive Co., Detroit.
Milwaukee Foundry Equipment Co., Milwaukee.
Mine Safety Appliances Co., Pittsburgh, Pa.
Modern Equipment Co., Port Washington, Wis.
Molybdenum Corp. of America, Pittsburgh.
Jas. A. Murphy & Co., Hamilton, Ohio.

N

Nassau Smelting & Refining Co., Inc., New York.
National Carbon Co., Inc., Carbon Products Div., New York.
National Engineering Co., Chicago.
National Gypsum Co., Buffalo.
Newaygo Engineering Co., Newaygo, Mich.
New Jersey Silica Sand Co., Millville, N. J.
Niagara Falls Smelting & Refining Corp., Buffalo.
Niagara Blower Co., Buffalo, N. Y.
Nichols Engineering & Res. Co., New York.
Wm. H. Nicholls Co., Inc., Richmond Hill, N. Y.
North American Smelting Co., Philadelphia.

O

S. Obermayer Co., Chicago.
Oliver Machinery Co., Grand Rapids, Mich.
Osborn Mfg. Co., Cleveland.

WILL YOUR FOUNDRY MAKE A PROFIT *Tomorrow?*

Here's How Despatch Oven and Furnace Engineering Service Can Help You Do It!

It's not going to be easy to make money tomorrow. But you'll stand a better chance if you maintain good customer service, high quality and keep production costs down.

Despatch engineers can help you do this. With 42 years of experience as specialists in foundry service, they can recommend the *best* Despatch foundry ovens and heat treating furnaces to suit your needs. You'll save labor . . . save time . . . save space . . . save fuel, on every job you handle.

These savings, added to exceptional performance, will help assure efficient, economical production — which is just what you'll need most tomorrow.

Save on 3 Foundry Jobs

In your laboratory, use Despatch ovens to test core sands, oils and binders. Get accurate data quickly; no wasteful full-scale tests in big ovens. Ideal for checking incoming raw materials. Four standard sizes; gas or electric. Prompt delivery. *Ask for Bulletin 105*

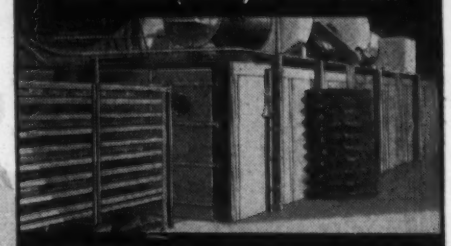
In your foundry use fast-baking, easy-loading, space-saving Despatch ovens for maximum performance. Types for core-baking and pasting, and for mold drying. You get the oven *best* suited to your needs, "foundry fitted" to the job. All types of conveyors, rack, batch and drawer-type ovens for large or small foundries. Plan to save more with a Despatch oven. *Ask for NEW Bulletin 31.*

In your heat treat department get results you want on every batch with a Despatch furnace. Stress-relief units for ferrous work; performance-tested heat-treating units for ferrous and non-ferrous use. Speedy, uniform, accurate and flexible; for temperatures to 1750° F. Completely automatic. Latest loading, handling, quenching systems. All types: pit, batch, rack-loaded, conveyor, auto-quench robot controlled models, etc. *Write for Bulletin 81 today!*

Visit the DESPATCH BOOTH at the FOUNDRY SHOW!

LABORATORY oven for testing.

VERTICAL conveyor core oven.



HORIZONTAL conveyor core oven.

CAR-LOADED Despatch core oven.

RACK TYPE Despatch core oven.

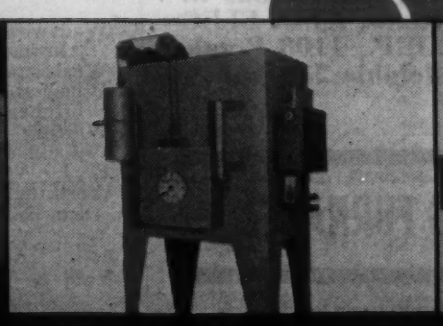
ROLLING DRAWER core oven.

PLATFORM loaded Al. type furnace.

RACK LOADED heat treat furnace.

DESPATCH OVEN COMPANY MINNEAPOLIS

CAR-bottom stress relief furnace.



BATCH TYPE heat treat furnace.

PIT TYPE heat treat furnace.

"Going Stronger than ever"

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MICAWASH

Mold and core washes for all metals

MICA-POT WASH

To keep Aluminum free from Iron Impregnation

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The Beryllium Aluminum Flux

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REFRACTORY MICA PRODUCTS, INC.

500 CHANCELLOR AVENUE, IRVINGTON, N. J.

HOW THE WROUGHT BRASS INDUSTRY CONSERVES METAL

No industry melting *commensurate tonnage of vital metal can quite match the brass mills for conservation and low melting losses. The savings of metal total millions of pounds; clearly the method they use is worth noting:**

Virtually all the brass mills in North America use the Ajax-Wyatt induction melting furnace, for it has the lowest metal losses in the field — less than 1% — with superior temperature control and unapproached economy of operation on high production schedules such as we have today.

Do you have your copy of "AJAX-METELECTRIC PROGRESS," the news magazine of induction melting, electric heat treating, non-ferrous ingot and alloys? Write to: AJAX ELECTRIC FURNACE CORP., 1108 Frankford Avenue, Philadelphia 23, Pa.

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P

Pangborn Corp., Hagerstown, Md.
Parsons Engineering Corp., Cleveland.
Peerless Mineral Products Co., Conneaut, Ohio.
Penn-Rillton Co., New York.
Pennsylvania Foundry Supply & Sand Co., Philadelphia.
Penola, Inc., Pittsburgh, Pa.
Penton Publishing Co., Cleveland.
Peters-Dalton, Inc., Detroit.
Geo. F. Pettinos, Philadelphia.
Picker X-Ray Corp., New York.
E. W. Pike & Co., Elizabeth, N. J.
Pittsburgh Crushed Steel Co., Pittsburgh, Pa.
Pittsburgh Lectromelt Furnace Corp., Pittsburgh, Pa.
Pollard Oil Products Co., Milwaukee.
Porter-Cable Machine Co., Syracuse, N. Y.
Powermatic Ventilator Co., Cleveland.
Pryo Clay Products Co., Oak Hill, Ohio.
Pyrometer Instrument Co., New York.

Q

Queen City Sand & Supply Co., Buffalo.

R

Radium Chemical Co., Inc., New York.
Ramtite Co., Div. S. Obermayer Co., Chicago.
N. Ransohoff, Inc., Cincinnati.
Reliable Pattern & Castings Co., Cincinnati.
Republic Coal & Coke Co., Chicago.
Republic Structural Iron Works, Cleveland.
Robins Conveyors, Inc., Passaic, N. J.
Rotor Tool Co., Cleveland.
Royer Foundry & Machine Co., Kingston, Pa.

S

Safety Engineering, New York.
Sand Products Corp., Detroit.
A. Schrader's Son, Brooklyn, N. Y.
Claude B. Schneible Co., Detroit.
Schramm, Inc., West Chester, Pa.
F. E. Schundler & Co., Inc., Joliet, Ill.
Scientific Cast Products Corp., Cleveland.
Semet Solvay Co., New York.
Severance Tool Industries, Inc., Saginaw, Mich.
Simplicity Engineering Co., Durand, Mich.
W. W. Sly Mfg. Co., Cleveland.
Smith Facing & Supply Co., Cleveland.
Smith Oil & Refining Co., Rockford, Ill.
Werner G. Smith Co., Div. Archer-Daniels-Midland Co., Cleveland.
Spencer Turbine Co., Hartford, Conn.
SPO, Inc., Cleveland.
Springfield Facing Co., Springfield, Mass.
Standard Conveyor Co., N. St. Paul.
Standard Horse Nail Corp., New Brighton, Pa.
Standard Sand & Machine Co., Chicago.
Steel Conversion & Supply Co., Pittsburgh, Pa.
Steel Shot and Grit Co., Boston, Mass.
Steelblast Abrasive Co., Cleveland.
Sterling Wheelbarrow Co., Milwaukee.
Frederic B. Stevens, Inc., Detroit.
Stroman Furnace & Engrg. Co., Chicago.
Swan-Finch Oil Corp., New York.
Syntron Co., Homer City, Pa.

T

Tabor Mfg. Co., Philadelphia.
Taggart & Co., Philadelphia.
Tamms Silica Co., Chicago.
Thomas Truck & Caster Co., Keokuk, Iowa.
Tiona Petroleum Co., Philadelphia.
Titanium Alloy Mfg. Co., Niagara Falls, N. Y.
Toledo Scale Co., Toledo, Ohio.
Tonawanda Iron Corp., No. Tonawanda, N. Y.
Treat-Nantke Co., Inc., No. Tonawanda, N. Y.
Tubular Micrometer Co., St. James, Minn.

U

United Compound Co., Buffalo.
United Oil Mfg. Co., Erie, Pa.
United States Graphite Co., Saginaw, Mich.
U. S. Gypsum Co., Chicago.
U. S. Hoffman Machinery Corp., New York.
U. S. Reduction Co., East Chicago, Ind.

V

Vanadium Corp. of America, New York.
Vesuvius Crucible Co., Swissvale, Pa.

W

Wadsworth Core Machine & Equipment Co., Akron, Ohio.
Western Metal Co., Chicago.
Wheelco Instruments Co., Chicago.
Whitehead Brothers Co., New York.
Whiting Corp., Harvey, Ill.
Willson Products, Inc., Reading, Pa.
E. J. Woodison Co., Detroit.
Worthington Pump & Machinery Corp., Harrison, N. J.

Y

Yale & Towne Mfg. Co., Philadelphia.

Z

Zanesville Sand Co., Zanesville, Ohio.

Annual Conference of Open-Hearth and Blast Furnace Operators

THIS YEAR that highly important joint conference of the Open-Hearth Steel Committee and the Blast Furnace and Raw Materials Committee of the American Institute of Mining and Metallurgical Engineers will be held at the William Penn Hotel in Pittsburgh, April 20 and 21. It is the 27th meeting. Last year this meeting was held in Cleveland.

Pittsburgh is certainly an appropriate meeting place for such a gathering — not only because of its central location in the steel industry as a whole but also because of its large pig iron and steel making capacity.

As in recent years, a fellowship dinner and reception will be a feature. It is scheduled for Thursday evening, April 20. All registrants at the conference are eligible to attend. The principal speaker will be John L. Perry, president, Carnegie-Illinois Steel Corp. and the toastmaster will be Henry A. Roemer, president, Sharon Steel Corp. The reception is given with the compliments of the Open-Hearth Executive Committee.

Group luncheons have been arranged for both Thursday and Friday, April 20 and 21. The one on Thursday is for all registrants and the one on Friday is for those attending the open-hearth sessions.

The program for this year's conference has been patterned very much after those of recent years. The sessions of both committees — open-hearth and blast furnace — are held simultaneously.

The Open-Hearth Sessions

The Open-Hearth Conference opens at 9:30 Thursday morning, April 20, with a brief general session, addressed by Leo F. Reinartz, general chairman of the committee, followed by a report of the McKune award committee, and the reading of the McKune award paper.

Basic and Acid Open-Hearth Practice

The first general session, following the general luncheon, is one of two basic and acid open-hearth technical sessions, presided over by J. L. Miller, asst. combustion engineer, Republic Steel Corp., Cleveland. The general topic is "Combustion in the Open-Hearth Furnace." Some of the general topics include physical and mechanical aspects of combustion, the use of powdered coal mixed with fuel oil, etc. This is the first of two sessions on basic and acid practice.

Simultaneous with the foregoing afternoon session is the other one devoted to technical phases of basic and acid open-hearth operations. The general subject is "Metallurgy of the Open-Hearth Process" with T. W. Washburn, asst. chief metallurgist, Inland Steel Co., in the chair. Some of the topics listed for discussion include: Slag-bath relations in the basic process, slag-bath relations in the acid process, hydrogen and nitrogen in steel, control of McQuaid-Ehn grain size, and hardenability intensifiers.

Basic Open-Hearth Operations

Most of the time of the annual conference is devoted to the basic open-hearth. There are four technical sessions assigned to this topic. The first is the one following the brief general meeting, Thursday morning, April 20. All day Friday, April 21, is devoted to the basic open-hearth, one session in the morning and two simultaneous gatherings in the afternoon.

The first technical session, following the brief general meeting Thursday morning, will be devoted to the basic open-hearth. The general topic for this meeting is "Maximum Production Problems." The chairman for this session is C. P. Spangler, industrial engineer, Jones & Laughlin Steel Corp. in the chair. Some of the topics listed for discussion include: Effect of sustained wartime production on open-hearth maintenance; use of new mechanical equipment to supplement manpower; hot metal mixers; use of sinter, nodules or briquettes; substitutes for fluorspar; and use of cupola iron in open-hearth furnaces.

The afternoon of Friday is devoted to two simultaneous sessions on basic open-hearth practice — one on "Quality" and the other on "Refractories and Masonry." The chairmen of the two sessions are respectively John J. Golden, superintendent steel production, Carnegie-Illinois Steel Corp., Gary, Ind., and W. S. Debenham, ceramic engineer, also of Carnegie-Illinois Steel Corp., Chicago.

Some of the topics for discussion at the session on "Quality" include: Recent slag control methods and objectives, control of carbon analysis, methods for determining residual alloying elements, bath temperature measurements, deoxidation practice and segregation problems.

For the simultaneous meeting on "Refractories and Masonry" the following subjects are listed for discussion: Life of refractories, new construction methods and refractory applications, and innovations in maintenance.

The Acid Open-Hearth

One session only is devoted solely to the acid open-hearth and this is scheduled for Thursday morning, April 20. The subject is "Quality" and the chairman is F. B. Foley, supt. of research, The Midvale Co., Philadelphia.

The acid furnace operators join, as indicated elsewhere, in meetings with the basic operators at sessions on the acid and basic open-hearth on "Combustion" and on "Metallurgy" of the open-hearth process on Thursday, April 20.

Blast Furnace and Raw Materials

All sessions of the Blast Furnace and Raw Materials Committee are held simultaneously with those of the Open-Hearth Committee.

The first session on Thursday morning, April 20, is devoted to "Coking Coals and Coke," with Harry A. Strain of the Carnegie-Illinois Steel Corp. in the chair. Two papers are to be presented, one on *"Selection of Good Coking Coals"* and the other on *"Manufacture of Beehive Coke."*

The afternoon session has as its topic "Ores." Three papers are scheduled for presentation: *"Agglomeration of Iron Ores"* by E. W. Davis; *"Some Comparisons between Iron Ores, Sinter and Nodules as Blast Furnace Feed,"* by T. L. Joseph; and *"New Developments in the Beneficiation of Iron Ores,"* by T. B. Counselman.

The two sessions scheduled for Friday, April 21, morning and afternoon, have as their main topics: "Sintering and Blast Furnace Filling" and "Ore and Coal Bedding" respectively. W. E. Brewster, asst. general supt., Wisconsin Steel Works, South Chicago, is chairman of both meetings.

For the first or morning session, two papers are listed, one on *"Sintering Plant Practice"* by H. F. Morgan and the other on *"Blast Furnace Filling"* by T. J. Wells.

The afternoon meeting is devoted to the topic, "Ore and Coal Bedding" for which one paper has thus far been scheduled entitled *"Ore and Coal Bedding"* by J. F. Meissner.

Now is the time to think about Molybdenum...

It is generally appreciated that the item of perishable tool costs is an important factor in manufacturing accounting. The possibility of savings offered by using molybdenum high speed steels, instead of tungsten types, is therefore worth consideration.

The savings are due first to the lower cost per pound of molybdenum steels, and second to their lower density. The latter results in more tools from an equivalent poundage.

The net savings effected naturally depend on tool performance. It is an established fact that, in a substantial majority of careful comparative tests made in the past, the performance of properly heat-treated molybdenum steels equaled, where it did not better, that of tungsten steels.

A consultation with your supplier should confirm these statements, but it would be a simple matter to check them in your own plant.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

ARMY E NAVY

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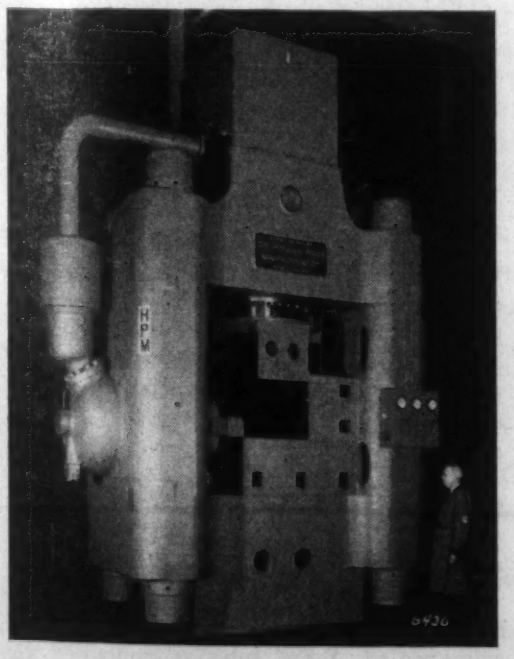
METALLURGICAL ENGINEERING news

Equipment • Finishes • Materials • Methods • Processes • Products
Alloys • Applications • Designs • People • Plants • Societies

Hydraulic Press for Powder Metallurgy

One of the largest hydraulic presses ever built for powder metallurgy is announced by the *Hydraulic Press Mfg. Co.*,



Mount Gilead, Ohio. It was designed for briquetting powdered carbides of tungsten, titanium or tantalum for carbide cutting tools, dies and inspection gages. It is also suited to other powdered metal forming requiring high pressure from two different points.

It will exert a 1500-ton downward acting force and a 1000-ton horizontal force. The machine really comprises two heavy press frames at right angles to each other. The downward ram has a maximum travel of 18 in., while the horizontal stroke is 6 in.

The press is completely self-contained, having two radial hydraulic pumps that generate the operating pressure. These are directly connected through flexible couplings to a 30 h.p. double-end-shaft electric motor.

Prefill valves provide direct communication between the overhead oil tank and the two pressure cylinders. As the rams advance, the cylinders are filled with oil by gravity. When the rams meet, resistance pump pressure quickly builds up on the work.

There is absolute control over all press movements, both as to speed and pressure.

Sealing Compound for Porous Castings

Magnesium, aluminum and other metal castings used in the aeronautical industry, particularly magnesium, have a tendency to be porous. The holes are virtually capillaries in size, but they have to be impregnated and sealed securely if they are to be used in high compression engines, especially where the wall must retain gasoline, oil and other solvent solutions.

Ault & Wiborg, Div. of Interchemical Corp., Cincinnati, have designed a synthetic resin for use with monomeric styrene that overcomes the inadequacy of drying oils. Called "No. 988 Magnesium Sealing Compound — Styrene Soluble," it is a 100% non-volatile compound, with viscosity of Y-Z on the Gardner-Holdt scale (18 to 25 poises).

The usual mixing proportion is equal parts of resin and styrene, which gives a viscosity of about 35 centipoises. If the pores are small, more styrene is used, 60 parts to 40 parts of resin; if large, 40 to 60.

The new resin cross-links with the styrene molecule during polymerization without the aid of any catalyst. Because of the linkage between the two molecules, the co-polymer is gasoline insoluble.

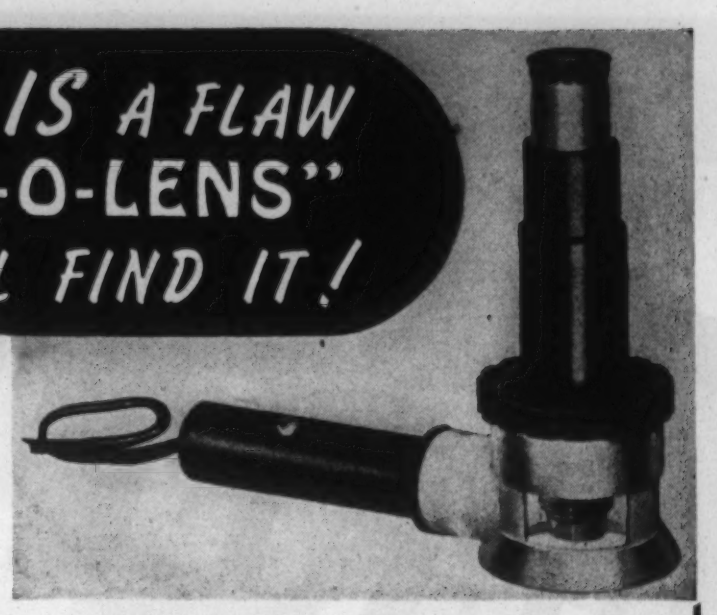
For sealing porous castings, the usual vacuum-pressure method is used, where the vacuum removes the air from the casting and the compound is forced in under pressure. After the casting has been impregnated, it is baked under pressure 2 hr. at 250 to 275 F. to polymerize the sealing compound. The sealing is very efficient, and seldom do the castings have to be re-run.

Standard industrial cleaners remove the synthetic resin-styrene solution from the outside of the castings after impregnating and before baking the sealing compound.

The new product was developed when others, such as china wood oil, became scarce and critical. Moreover, the new product is claimed to be superior to the ones it displaced.

● A license to manufacture Meehanite castings has been granted to *Russell Allport Co. & Pty., Ltd.*, Hobart, Tasmania, the largest foundry on the island, having supplied general castings for industry for over 50 years.

IF THERE IS A FLAW
"FLASH-O-LENS"
WILL FIND IT!



The new FLASH-O-LENS offers foundry-men, machinists, and many others engaged in producing metal parts for war contracts an efficient, economical means of examining the most minute defects during routine inspections.

FLASH-O-LENS consists of a portable 40x microscope combined with a perfect source of illumination in one convenient, compact unit . . . They are available in several models—powered by either standard flash light dry cells or by current from any AC or DC outlet—and with a selection of various combinations of lenses, all interchangeable in the one lens housing.

Send today for illustrated catalog describing the new FLASH-O-LENS

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PIKE

Manufacturers — ELIZABETH, N. J.

AMERICAN FOUNDRYMEN'S SHOW

April 25 to 28

Space No. 335

We will exhibit the following instruments:

G & D pH Meter
G & D Electro Titrator
Leitz Blosjo Carbon Meter
Leitz Mueller Photo-electric Colorimeter
Metallurgical Microscopes
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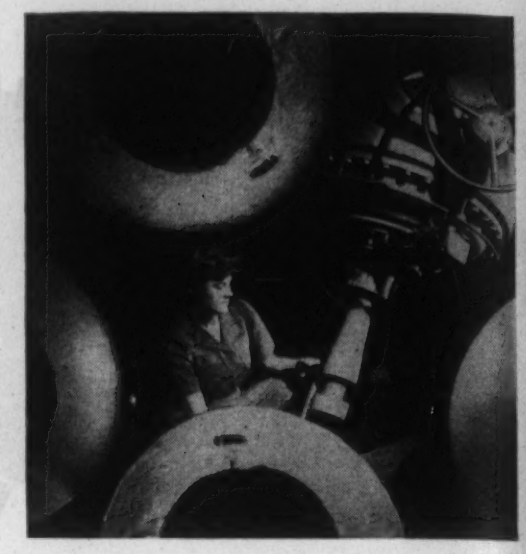
Photomicrographic Equipment

GAMMA INSTRUMENT COMPANY, INC.
New York 16, N. Y.

Portable 1,000,000-Volt Cameras

Girls in *General Electric Co.* plants are now operating portable 1,000,000-volt X-ray cameras built by the company. In the above illustration, the operator is setting



the equipment to look for flaws in the huge casting before it is machined.

The tube will make a picture through 4 in. of steel, 5 or 6 in. thick, almost as if it were made of glass. The X-ray energy of the equipment is worth $90,000,000 in radium.

● "Speedaloy" has been developed to fill the gap between high-speed steels and tungsten carbide. This cast tungsten-chromium-cobalt alloy is produced by the *Tungsten Alloy Mfg. Co.*, Newark, N. J., and is said to stand up better than high-speed steel, with higher shock resistance than tungsten carbide. It will machine all materials except manganese steel and chilled iron.

Miniature X-Ray Films

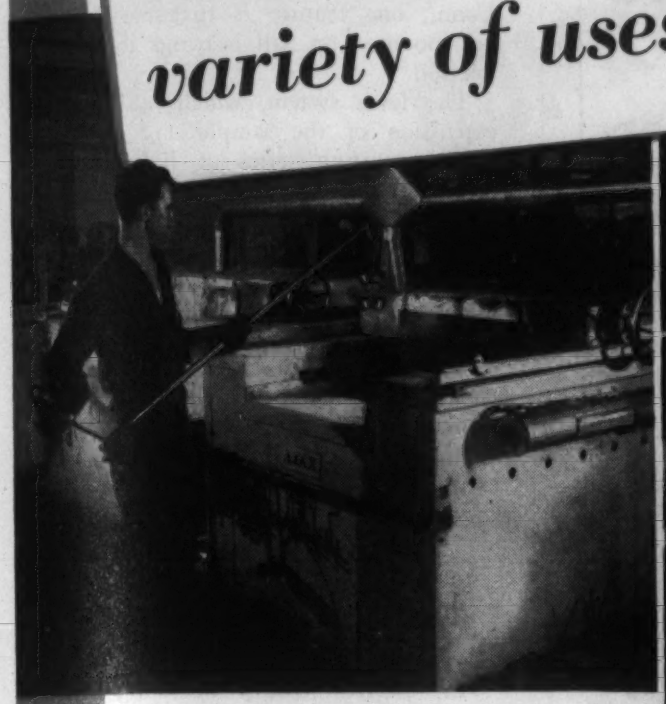
A radiograph that fits into the production line and provides photographic records for a nickel instead of $1.50 has been introduced by *Westinghouse*. A high-speed camera makes 2-in. film negatives (instead of standard larger sizes up to 14 x 7 in.) of any image cast upon a foot-square fluorescent screen.

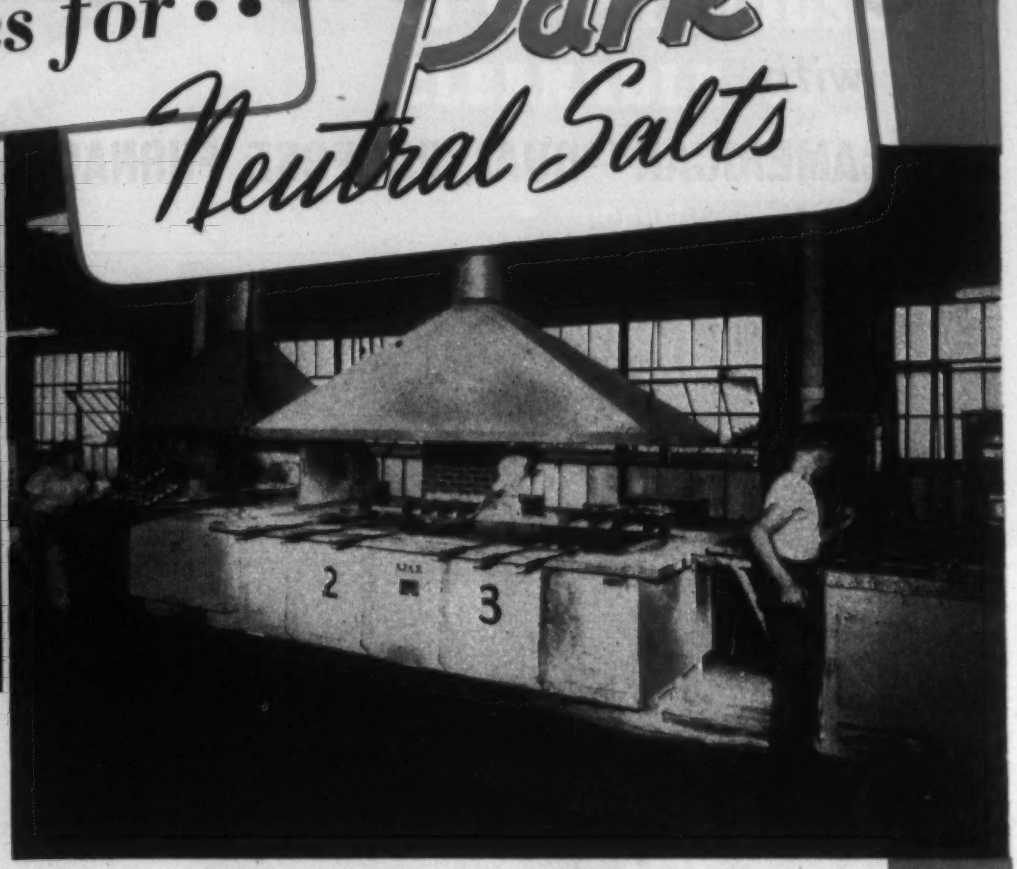
It photographs and reduces on miniature film the X-ray image on the screen. About 300 exposures can be made on a single 50-ft. continuous roll of film.

No special lead-lined surroundings are necessary. Made in two sections, the water-cooled X-ray tube is contained in the upper head, which is automatically controlled. This head must telescope and fit exactly with the lower section before an exposure can be made.

Such equipment is of particular importance just now when designers are stripping models of every part that does not contribute to strength or function. This makes it all the more necessary that flaws be detected early in the manufacturing process.

Industry finds wide variety of uses for •• Park Neutral Salts





★ *SMALL FURNACE—Neutral Salts used in hardening miscellaneous parts.*

★ *LARGE FURNACE—Fuse bodies and boosters hardened, quenched and drawn in salt baths.*

NEARLY EVERY DAY brings additions to the variety of parts heat-treated in neutral salt baths.

This trend was accelerated by the introduction of N.E. Steels, which require close temperature control and strict uniformity of heat treatment to produce the highest physical properties and maximum service performance.

Park's service metallurgists and research laboratory staff have rendered invaluable assistance to a large number of manufacturers by their development of proper salt baths and operating procedures.

The following parts are typical examples of parts heat treated by Park's neutral salt baths: Aircraft Parts, Automotive Parts, Tank Parts, Gun Parts, Truck Parts, Fuse Bodies and Boosters, Shells, Cartridge Cases, Gears, Hi-Speed and Carbon Tools, Screws, Bolts and Studs.

★ ★ ★

If you have a problem of heat treating any of the above, consult the Park Service Metallurgist in your territory—write or wire us direct.

Park

PARK CHEMICAL CO.
DETROIT . . . MICHIGAN

● Liquid and Solid Carburizers ☆ Cyanide, Neutral and High Speed Steel Salts ☆ Lead Pot Carbon ☆ Charcoal ☆ Coke ☆ No Carb. ☆ Carbon Preventer ☆ Quenching and Tempering Oils ☆ Drawing Salts ☆ Metal Cleaners ☆ Liquid Grain Cement

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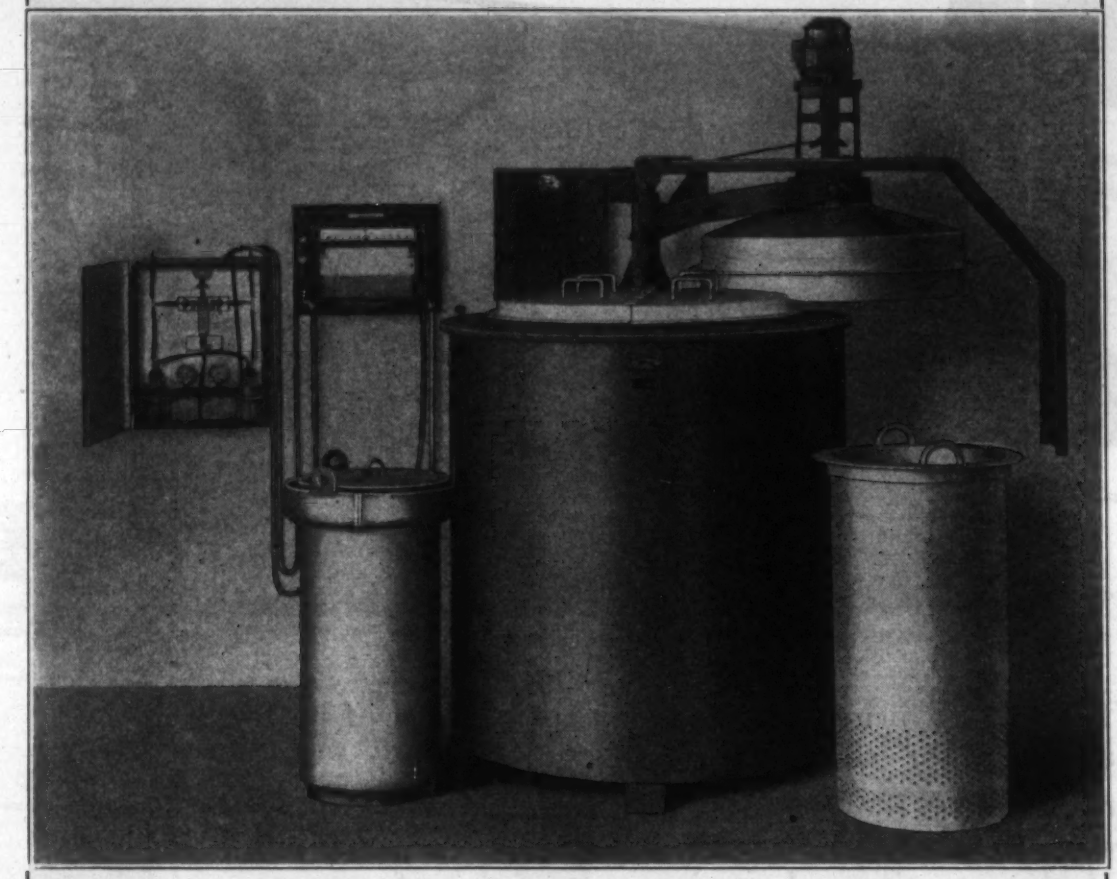
"AMERICAN" DUAL PURPOSE FURNACE



Model NA Air Tempering Furnace With Nitro Attachments

The pressure system together with precision control of time, temperature and flow of ammonia gas are resulting in unequalled advantages to the users of "AMERICAN" Electric Nitro Furnaces, and the "AMERICAN" Electric Air Tempering Furnaces with the Nitro attachments.

ARMY E NAVY

American Electric Furnace Company

29 Von Hillern St., Boston, Mass., U.S.A.

Industrial Furnaces for All Purposes

Dilatometer

The new and improved Bristol-Rockwell Dilatometer, Model A-134, draws two records simultaneously, one pen recording time against temperature, while the other jots down dilation against temperature. Made by the *Bristol Co.*, Waterbury 91, Conn., one feature is that moving parts are mounted on ball bearings to eliminate friction.

The lever system, which multiplies the expansion of the sample 112 times, has a compensating series of links embodied in it to remove any changes in the length of the parts due to heat from being shown on the record.

The mechanism for raising the tank for quenching the sample is built into the table with the operating handle mounted in a fixed position at the right side of the table. The furnace is circular and well insulated, and is split through the center so that the work to be examined can be easily mounted on the work platform.

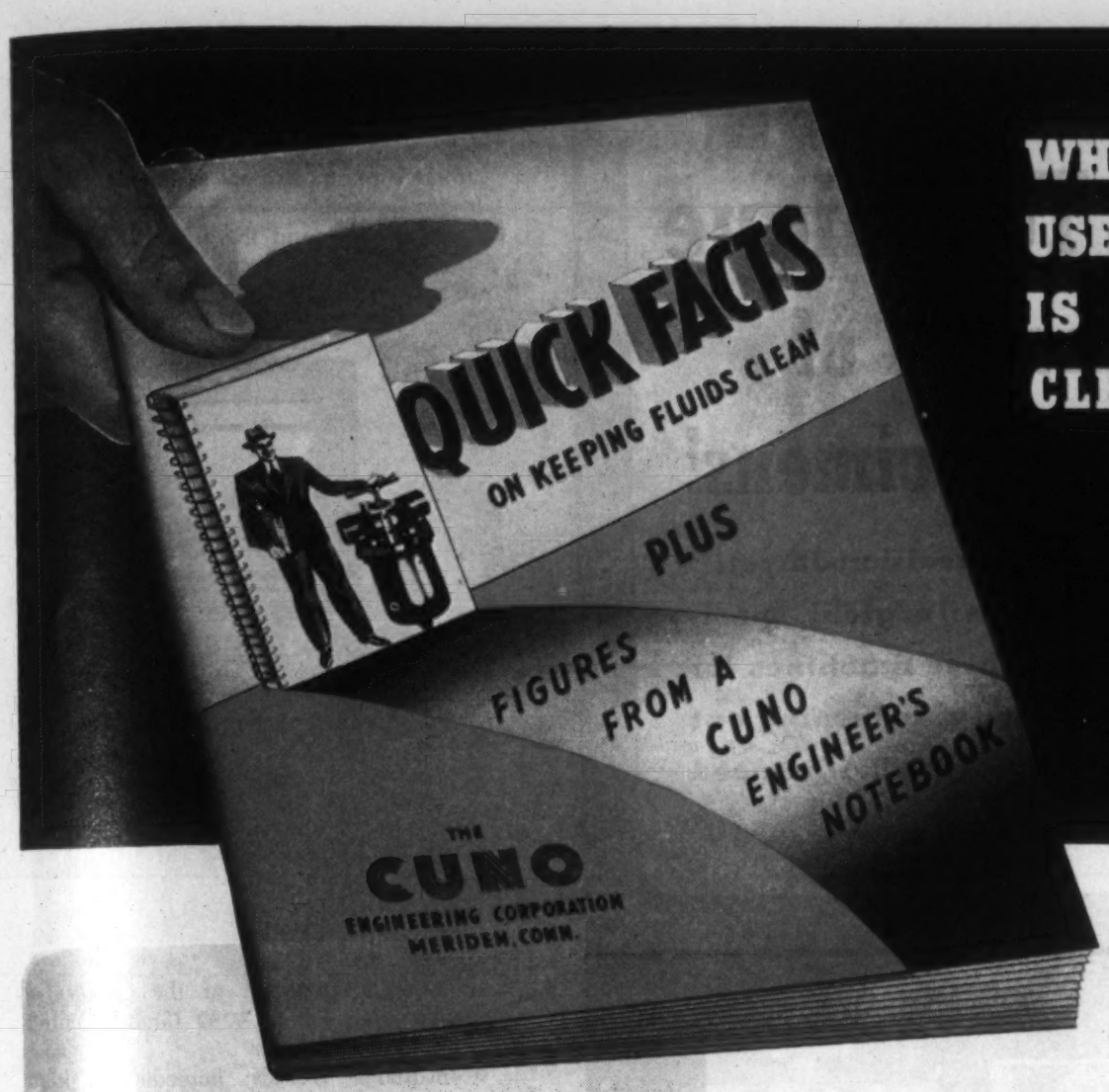
Motor for Grinding Small Holes

An electric motor operating at the record-breaking speed of 120,000 r.p.m. has been built by *General Electric Co.*, Schenectady, for application to internal grinding machines used in finish grinding small holes, many less than ¼ in. in diam. Another possibility is in driving small drill chucks for drilling tiny holes in soft metals, using drills 1/32 in. in diam. or less.

Surface speed needed for a high-grade finish by grinding should be the same whether grinding a large or small hole. For a small hole, only a tiny grinding wheel can be used, hence a high rotating speed is essential.

The new motor is 3 h.p. and weighs 7 lb. The motor fits into the palm of a man's hand while its rotor is scarcely larger than a man's thumb. Water cooling is used, ½ gal. per min.

In the accompanying photograph the grinding wheel can be seen at the end of the shaft.



WHERE CAN YOU USE A FILTER THAT IS CONTINUOUSLY CLEANABLE . . .

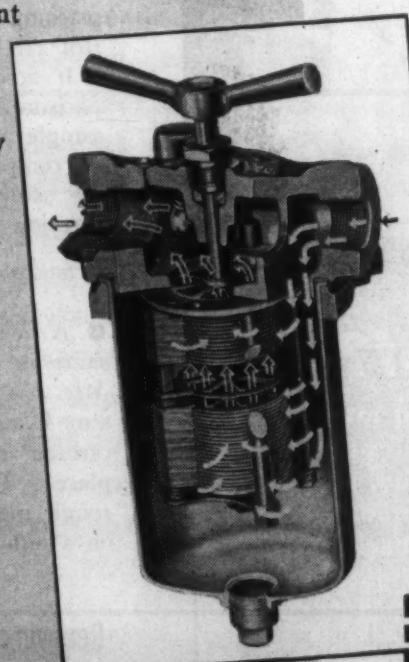
- compact
- lightweight
- noncollapsible
- easily adaptable to automatic self-cleaning

CHAPTERS ON SUCH APPLICATIONS AS:

- Burners and combustion controls
- Diesel engines
- Food production equipment
- Gasoline engines
- Machine tools
- Metal-working machinery
- Paints, coatings, finishes
- Process industry equipment
- Steel mill lubricating, descaling, cooling systems
- Turbines, blowers, compressors, etc.

Both types of Cuno Filters are described—

CUNO "AUTO-KLEAN"
mechanical cleaning
CUNO "FLO-KLEAN"
hydraulic cleaning



You can get *quick facts* on the operation and application of Cuno "Filter-Fine" Strainers by writing for the free 36-page booklet "Quick Facts".

IT TELLS . . .

1. How the Cuno Filter may be mounted externally or built into the machine
2. How full flow can be handled by a single Cuno filter no larger than the ordinary partial-flow type
3. How the filter can be cleaned without interrupting fluid flow
4. Why build-up of sticky residue is avoided by an exclusive feature
5. Why the cartridge never needs to be removed for renewal or cleaning
6. Why the filter element will last as long as the equipment on which it is installed
7. How its all-metal construction permits use under a wide range of pressure, temperature, corrosive and erosive conditions

CUNO ENGINEERING CORPORATION
454 South Vine Street
Meriden, Conn.

Please send me a free copy of QUICK FACTS

NAME.....

COMPANY.....

ADDRESS.....

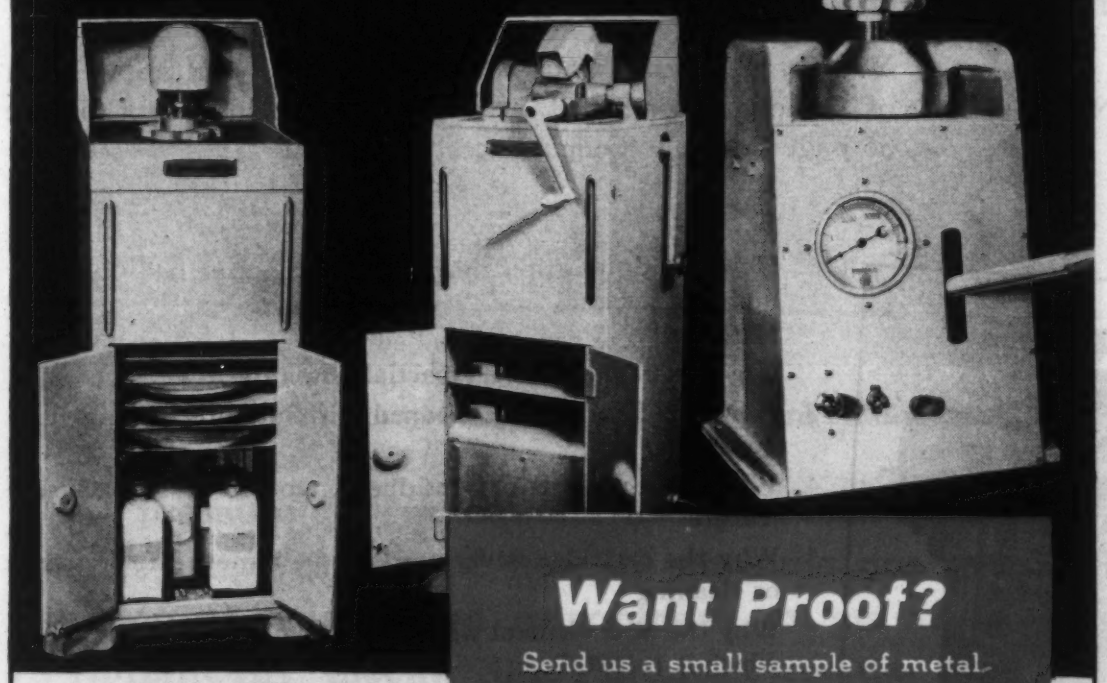
KEEP FLOW ON "GO" WITH

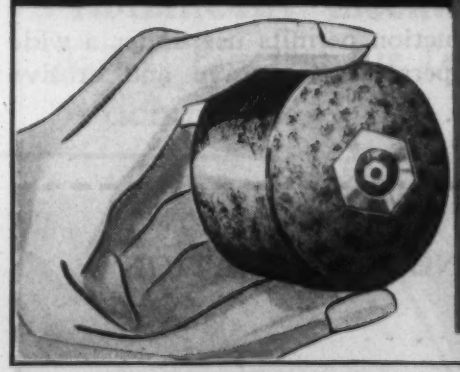
CUNO

THE "FILTER-FINE" STRAINER

Advanced Technique for preparation of metallurgical specimens!

In one typical installation of "Precision-Jarrett" apparatus for preparing metallurgical specimens, one operator running three machines for cutting, mounting and polishing, is turning out 80 finished specimens per 8 hr. day! Advanced technique is the answer . . .





Want Proof?

Send us a small sample of metal you must polish. We will cut it, mount it in a Bakelite plug, polish it ready for microscopic examination, and send it back to you. You will not be obligated!

Metal specimen embedded in Bakelite plug, ready for microscopic examination. Hydraulic press molds plug in 8 minutes.

PRECISION-JARRETT

Metallurgical Apparatus *manufactured by*

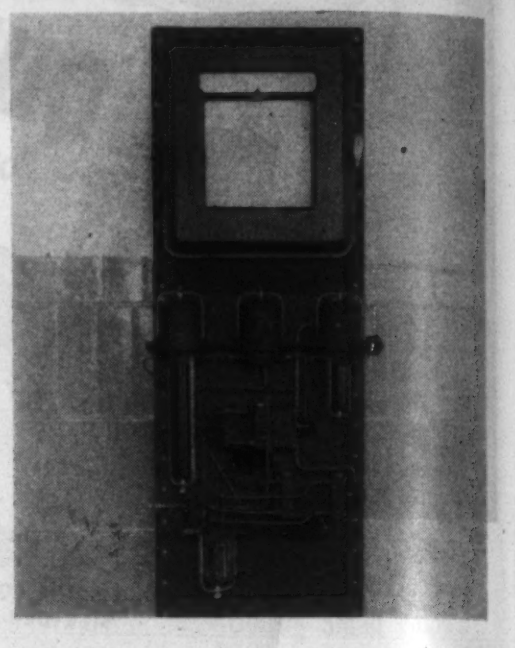
PRECISION SCIENTIFIC CO.

1750 N. SPRINGFIELD AVENUE, CHICAGO 47, ILL.

Engineers and builders of laboratory equipment

Four-Point Gas Analyzer

A 4-point gas analyzer provides a continuous record of the analysis of oxygen, carbon dioxide, carbon monoxide and hydrogen in combustion processes on a 10-in. strip chart, and the four different registrations, one for each gas, are shown by different colors and numbers on the chart.



It is a development of the *Cambridge Instrument Co., Inc.*, 3732 Grand Central Terminal, New York.

Continuous records immediately indicate the varying percentages of the four gases in any chosen zone of the flame. The equipment is of interest to chemists, metallurgists, oil engineers and others.

The complete analyzer operates directly from the a.c. current supply line. It can be furnished with contacts for operating warning signals or to actuate various control circuits.

It accomplishes analysis by direct comparison of thermal conductivity of the sample with that of a reference gas or by comparison of thermal conductivity of the sample before and after chemical absorption or combustion.

● A new hone for keeping machine tools sharp is announced by the *Tungsten Alloy Mfg. Co.*, Newark, N. J. In these "Temaloy Diamond" hones a matrix of tungsten carbide holds the diamonds securely in place. They come in three grit grades: rough, medium and fine. They are mounted on a non-slip handle.

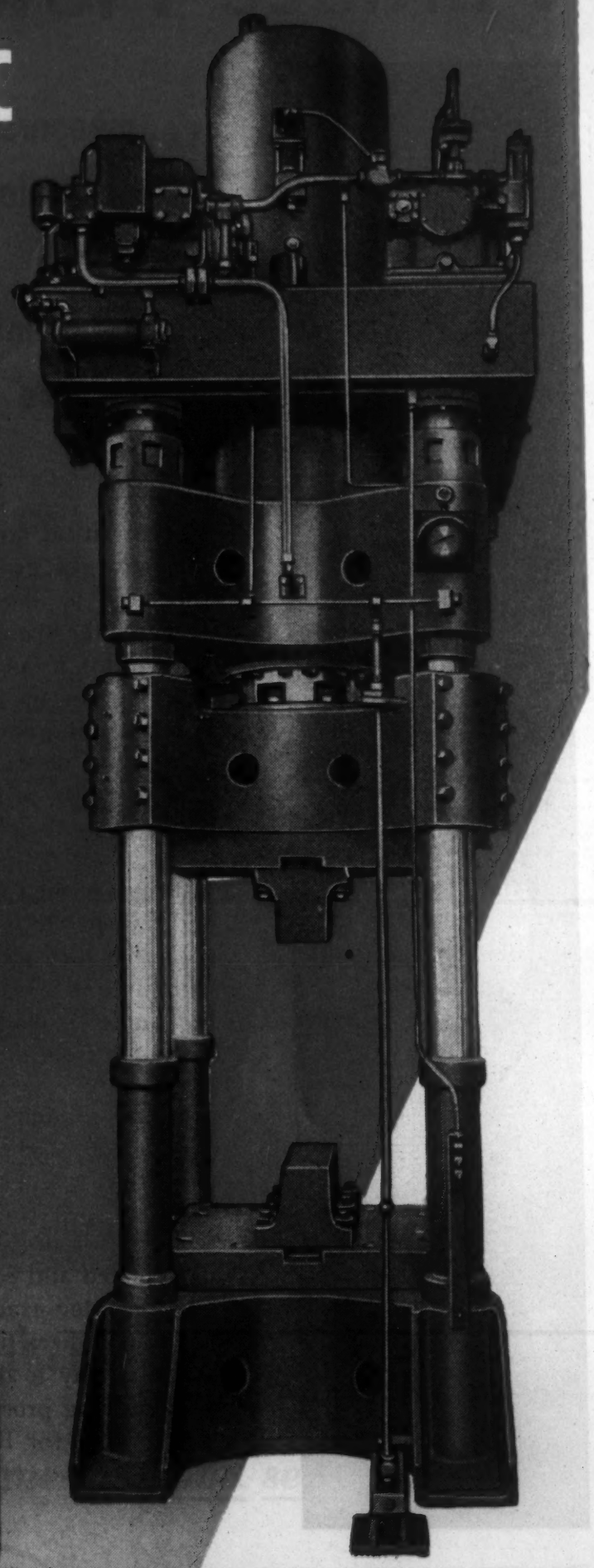
Recovery of Metal Inserts from Plastics

For salvaging metal inserts in plastic parts, the former method was to burn away the plastic and clean the resultant carbonized film, which was not satisfactory.

"Metex Plastic Stripper" has been introduced by *MacDermid, Inc.*, Waterbury 88, Conn., which disintegrates the plastic by simple immersion in a boiling water solution of this stripper. The metal is left clean and ready for reuse.

Plastics of the thermosetting and transfer type may be thus disintegrated, and all metals except aluminum and zinc may be salvaged.

PRESENTING NEW STRAIGHT HYDRAULIC HIGH-SPEED HOT METAL FORGING PRESSES



For hot-metal forging in heavy metal-working industries, Watson-Stillman presents a new line of Straight Hydraulic Forging Presses. These presses are suitable for forging ferrous or non-ferrous metals. Hydraulic pressure is generated by direct-connected, motor-driven, radial piston oil pumps. Smooth power application permits proper metal flow. The kneading action penetrates the forging. These features result in improved grain structure and eliminate sharp die impact. The prefill system and circuit design permits shockless press reversal, rapid traverse and planishing speeds, and reduces pressure build-up time to a minimum. No auxiliary steam boiler, accumulator or intensifier is needed. These new presses are built into complete, self-contained units with a single hand lever controlling all press movements. Write us today for more detailed information on the new line of presses. The Watson-Stillman Co., Roselle, N. J.

The new 500-Ton Metal Forging Press shown here has a 36-inch stroke and a platen area of 37¾ in. by 48 in. Its anvils are 8 in. wide, 12¼ in. high and 30 in. long. Overall base dimensions are 9 ft. by 6 ft.; height is 20 ft. 2 in.

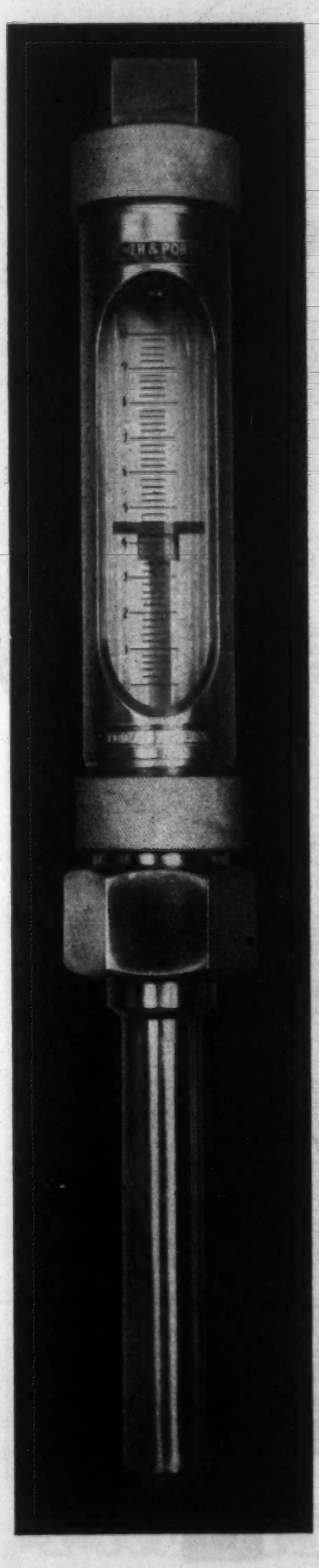
WATSON-STILLMAN

DESIGNERS AND MANUFACTURERS OF HYDRAULIC EQUIPMENT AND MACHINERY, FORGED STEEL FITTINGS, AND VALVES

5386

FISCHER & PORTER

Furnace Flow Guide



. . . measures gas flows accurately

. . . helps maintain proper furnace conditions

The critical flow rates of gas and air to inert gas generators are accurately measured by the "Furnace Flo-Guide." It warns the operator immediately of any change by means of the visible float which moves up or down in direct proportion to the flow rate. Its accuracy is guaranteed by the precision-bore pyrex metering tube, fashioned by the exclusive F & P "Glo-Tech" process.

The metering tube is also non-corrosive and transparent, so that the operator can tell when dirt accumulates or interferes with accurate readings. The "Furnace Flo-Guide" is readily cleaned without removing it from the line.

Flow pulsations are dampened by the oil dashpot attached to the bottom fitting of the meter.

The "Furnace Flo-Guide" is moderately priced and easily installed. It tells your operator exactly what he is doing, and standardizes the results you will obtain from day to day in your hardening and annealing processes. For full information write for Bulletin 30-C.

FISCHER & PORTER CO.

664 COUNTY LINE ROAD HATBORO, PA.

F&P ROTAMETERS

Coating for Magnesium Alloys

An anodic film that makes magnesium alloys as non-corrosive and abrasion resistant as aluminum alloys is announced by *Consolidated Vultee Aircraft Corp.*, San Diego, Calif. The film is extremely tight and very resistant to electrical current and abrasion. It will withstand the potential of 110 v.

Tests show that magnesium alloys coated with the new finish hold up as well, or better, than anodized duraluminum, and abrasion resistance is 50 to 100 times superior. Because of smoothness of finish and ability to introduce a wide variety of dies, post-war possibilities seem good.

Apparently the new coating has not been named as yet.

● Designed for quick removal of oils and solid particle dirts and greases, especially those hard and caked on, "Running Gear" is an emulsifiable type cleaner, made by *Technical Processes Div., Colonial Alloys Co.*, Colonial Philadelphia Bldg., Philadelphia 34. It is an ideal cleaner for metals in general. It cleans smut on steels; polishing, buffing, drawing and stamping compounds, and many slushing oils.

Pure Aluminum Bonded to Steel

The chemical bonding of pure aluminum to steel, the resulting product being used in cylinder barrels in aircraft engines, provides a marked reduction in the structural weight of an aircooled engine, and greatly improves the cooling efficiency of its cylinders.

The process has been developed by the *Al-Fin Corp.*, subsidiary of the *Fairchild Engine & Airplane Corp.*, 30 Rockefeller Plaza, New York.

The bond formed between the steel and the pure aluminum is 100%, since the composition of the bond forms a perfect bridge for the transmission of heat from the steel barrel to the pure aluminum cooling fins.

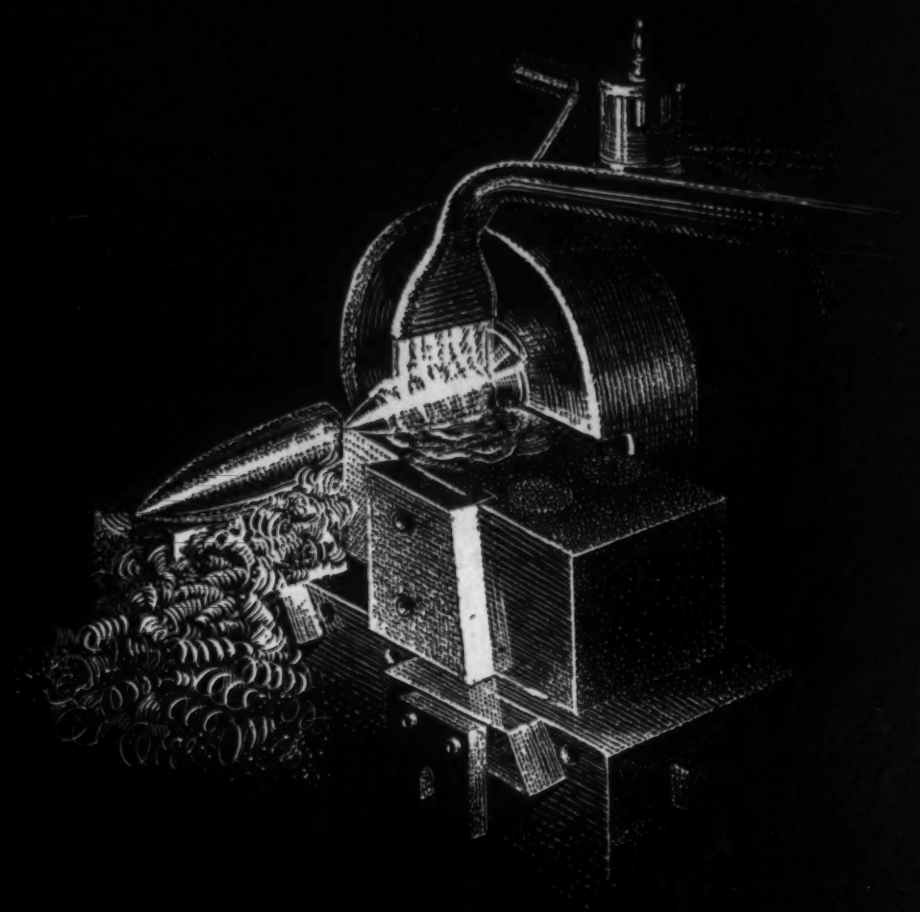
The process makes the ductile aluminum expand and contract along with the more rigid steel, and supplements the steel with the heat dissipating qualities inherent in the lighter metal. By test it is stronger than the conventional composite cylinder barrel.

The ferric-aluminum bond of Al-Fin has a rupture strength greater than that of pure aluminum. An engine with Al-Fin uses 37% of the drop of pressure, 55% of the quantity of air, and 22% of the cooling air horsepower, as compared with a conventional steel-finned barrel.

No failure of the bond between steel and aluminum was detected after 85 hr. of operation at power outputs ranging from normal to 140% of normal.

Hardness of the barrels is well within the standard limit of 29 to 34 Rockwell C. Thickness of the bond is 0.0005 to 0.00075 in.

EXAMPLE OF *Service*:



A manufacturer now turning out shell casings asked one of our Cities Service Lubrication Engineers to make a survey of his machining operations . . . Our engineer recommended certain changes, including the use of a new *transparent* blend of Cities Service Cutting Oil, which permits full visibility during the cutting operation. RESULTS: Tool life increased by 20% . . . cutting oil cost cut 25% . . . production efficiency and quality of work both improved.

More and more, it's service that counts . . .

and *Cities Service* means good service!

CITIES SERVICE OILS — ONCE-ALWAYS

CITIES SERVICE OIL COMPANY

ARKANSAS FUEL OIL COMPANY

Prelude TO A PERFECT FINISH

CHICAGO

MOUNTED WHEELS and Small GRINDING WHEELS

A complete range of styles, grains and sizes up to 3" in diameter to give you a perfect finish on every job.

PROMPT DELIVERY

Specialization — with full WPB approval—on sizes 3" in diameter and under, means no waiting for Chicago Grinding or Mounted Wheels. Let us take care of your present and post-war requirements.

YES, YOU CAN FINISH IT BETTER WITH A CHICAGO WHEEL

Just as the prelude to a new world is better tools of war, so the prelude to a perfect finish is better grinding wheels.

Today's standards of finishes are far and beyond those of yesterday. To acquire them without sacrifice of production time is a goal which everyone seeks.

Finish must now be measured in micro inches. That's where the new Chicago **FV BOND** Wheels excel. They give a precision smoothness so intensified that it passes any surface analyzer test, in many cases eliminating hand lapping and auxiliary finishing operations.

FREE Engineering Analysis

If you have a grinding job that presents a problem because of the nature of material, tricky shape or other reason, tell us about it. Our experts will go into a huddle and give you the benefit of our long experience making millions of custom built wheels for every conceivable operation.

HERE'S WHAT MAKES CHICAGO WHEELS CLICK—

A—Sensational new FV BOND. Result of research and experiment on hundreds of aircraft jobs.

B—No sacrifice of cutting time or wheel life.

FV BOND is available in all types of Chicago Mounted and Small Grinding Wheels—in all abrasives, grain and grade combinations.

TEST WHEEL FREE—To prove their superiority in your own shop, send for a Chicago Wheel made with **FV BOND.** Give us details of the job, material you want to finish and we'll do the rest.

Write for Catalog and interesting Engineering Survey Form

Half a Century of Specialization has Established our Reputation as the Small Wheel People of the Abrasive Industry.

CHICAGO WHEEL & MFG. CO.

1101 West Monroe St., Dept. ME, Chicago 7, Ill.

Send Catalog and Survey Form. Interested in
☐ Grinding Wheels
☐ Mounted Wheels
☐ Send Test Wheel

NAME .....

Title .....

ADDRESS .....

Open-Back Inclinable Press

A new 150-ton press for shallow forming, blanking and punching has been announced by the *Ferracute Machine Co.*, Bridgeton, N. J. The press, C 36½, is an addition to a complete series of 15 presses, ranging in size from 1¼ in. diam. shaft to 7 in.

It is an improved open-back inclinable press, geared type, with jaw clutch, but obtainable with pneumatic friction clutch and brake. Because of the new design, weight of press and floor space needed have been reduced without sacrificing strength and rigidity.

The stroke ranges from 6 to 13 in. The bed measures 32 in. front to back by 50 in. right to left, and features built-in ram balance, anti-friction bearings in removable bearing sleeve, and many other features.

● New plastic faces are now available for the "Basa" replaceable face hammers and "Empire" mallets, made by *Greene, Tweed & Co.*, 4377 Bronx Boulevard, New York 66. They substitute for scarce rawhide, but are the same dimensions and weights. The plastics are tough and resilient, will not chip, split or mushroom, nor mar the struck surface.

Huge Billet Shear

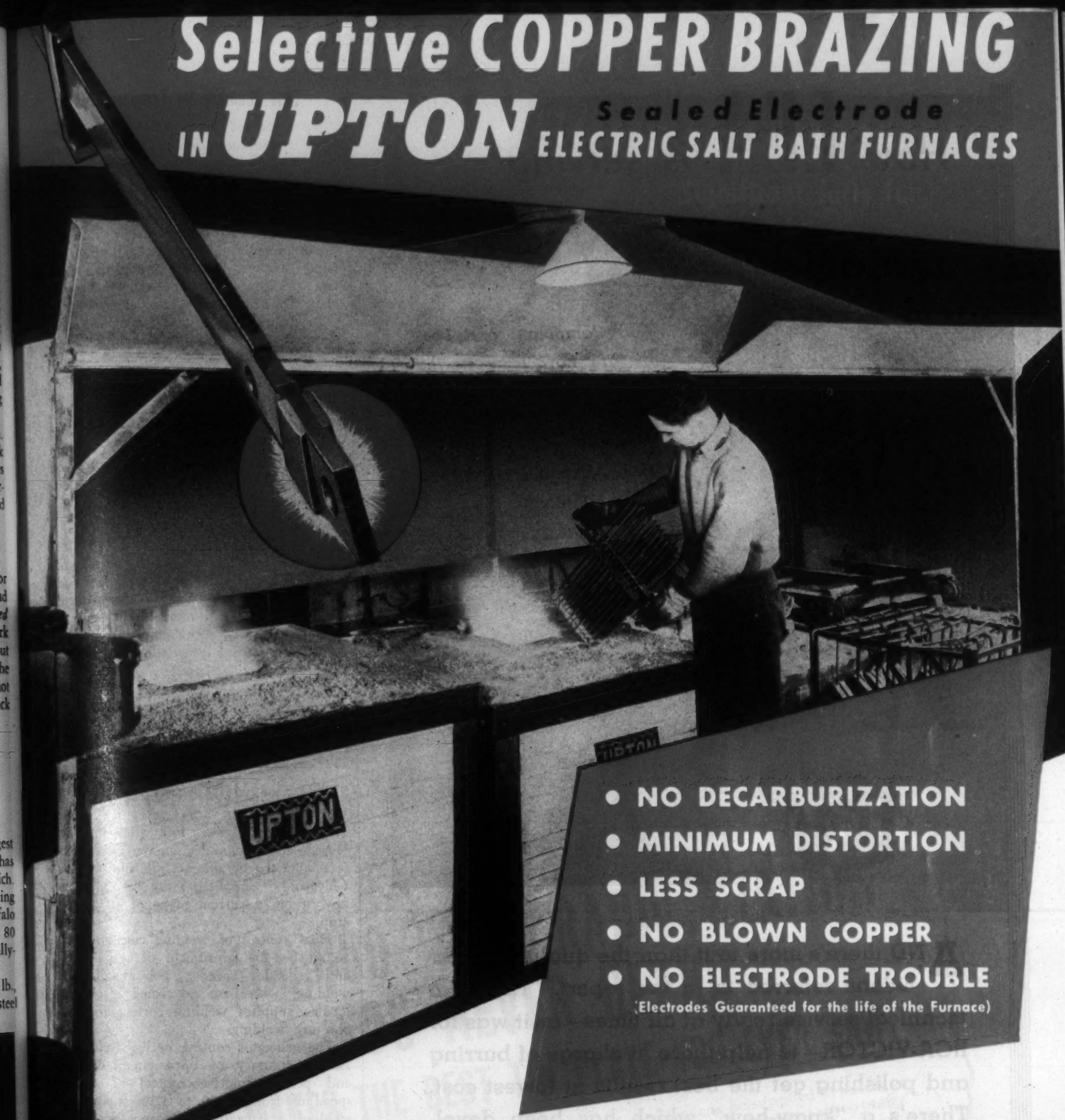
A billet shear, believed to be the largest machine of its type ever constructed, has been installed in the Melvindale, Mich. plant, *Timken-Detroit Axle Co.*, having been designed and built by the Buffalo Forge Co., Buffalo. Weighing over 80 tons, this No. 17 shear has an electrically-welded "armor plate" frame.

Pressure on the knives is 4,500,000 lb., allowing six cuts per min. on 10-in. steel

bars. Clutch and hold-down are air operated, with automatic pressure lubrication.

The whole unit is operated by a 125 h.p. motor that drives the flywheel through multiple V-belts.

Selective COPPER BRAZING IN UPTON Sealed Electrode ELECTRIC SALT BATH FURNACES



- NO DECARBURIZATION
- MINIMUM DISTORTION
- LESS SCRAP
- NO BLOWN COPPER
- NO ELECTRODE TROUBLE

(Electrodes Guaranteed for the life of the Furnace)

Selective Brazing of ordnance part subjected to intense impact is being handled at high speeds in Upton Electric Salt Bath Furnaces.

Complete absence of any noticeable decarburization permits re-hardening following the brazing operation. The selective brazing practical only in the salt bath furnace eliminates most of the distortion found in other processes. The salt quench stops the flow of copper, but does not cause it to "blow" or form a blob on the surface.

These same furnaces, in the shop of a commercial heat treating concern, are being used, alternately, for high speed steel hardening and copper brazing.

When inquiring for additional information, please give complete details on your problem so that our answer to you can be complete.

See a battery of Upton furnaces in operation. In Detroit there is an installation of Upton Electric Salt Bath Furnaces kept in operation for your inspection. You are cordially invited to inspect this installation to see the type of work possible only with an Upton Electric Bath Furnace.

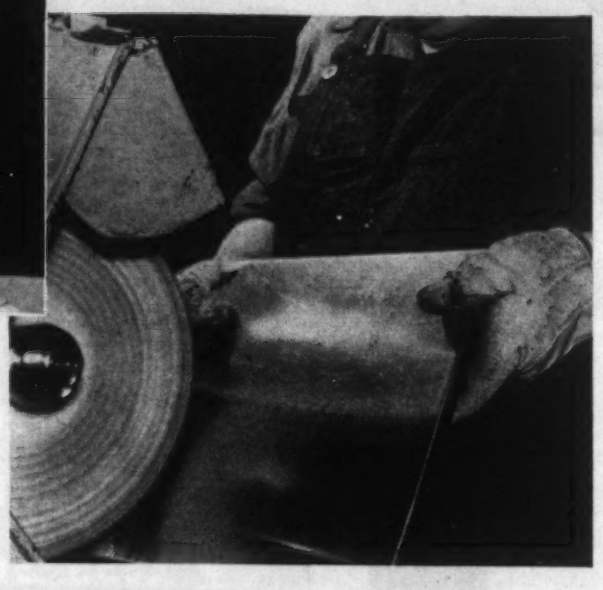
Upton ELECTRIC FURNACE DIV.

COMMERCE PATTERN FOUNDRY AND MACHINE COMPANY

7425 MELVILLE AT GREEN DETROIT 15, MICHIGAN

How LEA is serving RCA-VICTOR

"Lea Compound and Lea-rok are now used in the burring and polishing of many types of metals used in this company's Camden, N. J. plant, the chief one being aluminum."



AND there's more to it than the quality compositions referred to in the report. There's a technical service ready at all times—as it was for RCA-VICTOR—to help those in charge of burring and polishing get the best results at lowest cost. There's a "know-how" which has been developed over a period of many years of service to industry.

If you have a burring problem . . . a polishing problem . . . or a buffing problem—why not call on Lea?

THE LEA MANUFACTURING CO.

Waterbury 86, Conn.

Burring, Buffing and Polishing . . . Manufacturers and Specialists in the Development of Production Methods and Compositions

A-T-M-6

Test Chamber for Temperatures

An improved test chamber for high and low temperature, Model RTC-1, is announced by *American Coils, Inc.*, Newark, N. J.

Its important features are the four individually-operated plugs in the lower panel of the door that permit ready access to the interior of the testing chamber. The hand may be inserted through an insulated passage and the position of the part being tested can be adjusted.

In the case of a regulating instrument being tested, its reading may be changed, so that the test can be continued without removing it from the cabinet, or disturbing the other pieces being tested and affecting their accuracy.

It is completely automatic, and can produce any desired temperature between minus 70 C. to 158.8 C. A precision mechanism assures scientific control of all temperatures.

● A new type low-loss resistor coating for coils, of a vitreous nature, with the trade name of Lectraseel, is now being marketed by *Pemco Corp.*, Baltimore. It is highly resistant to thermal shock, and its coefficient of expansion usually parallels that of ceramic cores now in use.

Engine-Driven Welder

A new "Shield-Arc" engine-driven welder rated at 200 amp. of light weight rugged construction with powerful enclosed rubber mounted engine of 29 h.p. is announced by the *Lincoln Electric Co.*, Cleveland. Supplied with base and canopy, it has a current range of 40 to 200 amp.

Dual control of welding current is accomplished by adjustment of series fields and generator speed. For metallic arc welding, with bare or coated electrodes, it also supplies welding current for carbon arc welding.

The generator control, or "job selector," assures accuracy of open circuit voltage and permits precise control of engine speed of from 1,500 to 1,150 r.p.m. for welding. It will also manually reduce the engine speed to as low as 750 r.p.m. to stop welding at intervals of a few minutes.

For the majority of work, a speed of 1,150 to 1,400 r.p.m. is used.

● One of the largest multiple thread milling cutters ever produced is offered by *Plan-O-Mill Corp.*, 1501 E. Eight Mile Road, Hazel Park, Mich. It is used for threading gun tubes, breech blocks and other parts up to 16 in. diam. It is 12¾ in. long and 6½ in. diam. The design problem was solved by segmenting the cutter. It provides a spiral gash cutting action for smoother milling and improved work finish, with straight gash grinding. The cutter provides the Higbee cut by which the imperfect thread is removed coincidental with milling the thread.

A 400,000 WATT RADIO STATION YOU NEVER HEARD

...MAKES THE BEST TIN PLATE YOU EVER SAW!

Through constant research for new ways to make things better, Granite City Tin Plate is now made by the electrolytic method. Equipment capable of generating 400,000 watts of high frequency radio energy fuses and brightens the tin coating faster and better. The more uniform and accurate control provides a superior surface for subsequent manufacture. By this method, tin plate can be supplied in sheets or coils for postwar production—just as you prefer.

This improved tin plate is significant of the many Granite City developments which mean better steel products for postwar planners. If your ideas for the future are stumped by the need of a special kind of steel, write or contact our nearest branch office.

If you are looking to the future, keep your eye on Granite City Steel

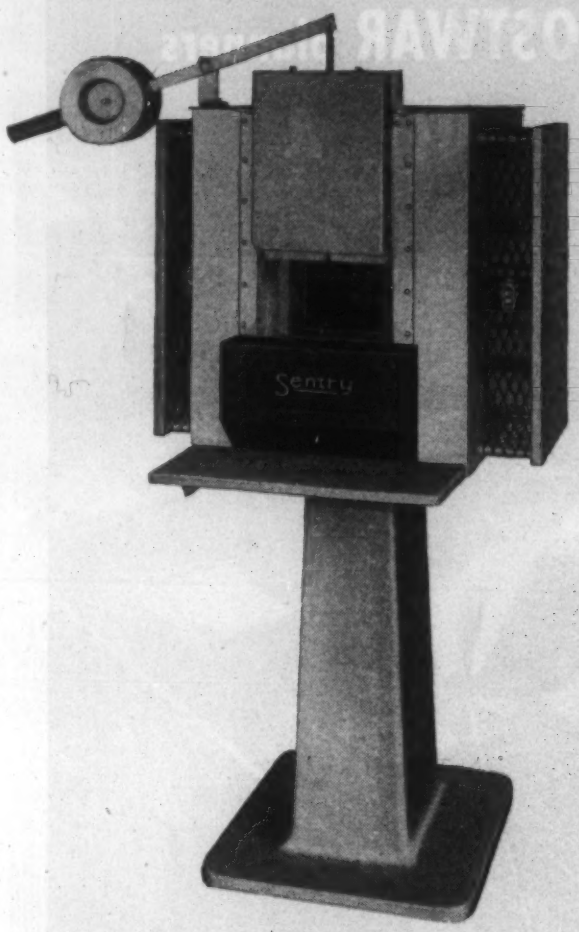
SINCE GRANITE CITY STEEL 1878

GRANITE CITY STEEL CO.

Chicago • Cleveland • Denver • Houston • Indianapolis
Kansas City • Los Angeles • Louisville • Memphis • Milwaukee • Minneapolis • Moline • New York • St. Louis

HOT ROLLED SHEETS • COLD ROLLED SHEETS • STRIPLATES • TIN PLATE • TERNE PLATE • ELECTRICAL SHEETS • TIN MILL PRODUCTS • PORCELAIN ENAMELING SHEETS

PERFORMANCE!!!



Sentry Model "Y"
High Speed Steel Hardening Furnace

With Sentry Equipment and Sentry Diamond Blocks **enabling quality hardening of ANY TYPE of High Speed Steel, one user changed over to general use of H. S. Steel Cutters, Drills and Punches.**

•

Comparative figures below show how *Sentry* more than paid for itself within a short time.

•

TOOL	FORMER STEEL USED	*Sentry* HARDENED H.S. STEEL
Cutter	400 Parts per Cutter	2600 Parts per Cutter
"	2 to 4 Hours Production	26 to 40 Hours Production
Drill	350 Holes per Drill	3350 Holes per Drill
Punch	150-300 Parts per Punch (Avg.)	4180 Parts per Punch (Avg.)
"	1200 " " " "	14300 " " " "

•

You too can gain by changing over to *Sentry* and High Speed Steel. Investigate Now ! !

•

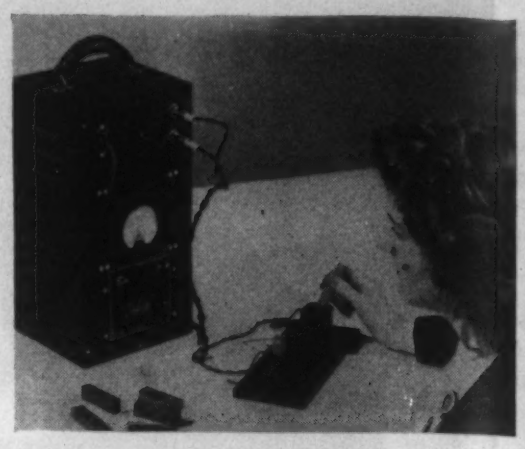
Write for Bulletin 1020-4C

Sentry — "Always on Duty"

The Sentry Company
FOXBORO, MASS., U.S.A.

Magnetic Comparator

Differences from standard in ferrous parts, such as caused by wrong composition, improper heat treatment, off-standard hardness, size or other properties that affect the magnetic flux within the coil are



revealed in a new magnetic comparator, put out by the Special Products Div., *General Electric Co.* The difference is shown as unbalance on the comparator's indicating instrument, which reads within passing limits when the tested part is acceptable.

It can distinguish between steels whose hardness varies as little as two points Rockwell when hardness is the sole variable. A feature is that it provides a non-destructive test.

The comparator consists of a variable-voltage transformer, a sensitivity control rheostat, coarse and fine balance control rheostats and the required capacitors — all mounted in a portable, steel case.

● Pure water needs of electroplating plants can be served by a new process that will produce "de-ionized" water fit for any chemical or industrial purpose. It replaces distilled water at a fraction of the cost. It contains from two to ten parts per million of dissolved solids. Developed by the *Illinois Water Treatment Co.*, it is sold by *Hanson-Van Winkle-Munning Co.*, Matawan, N. J.

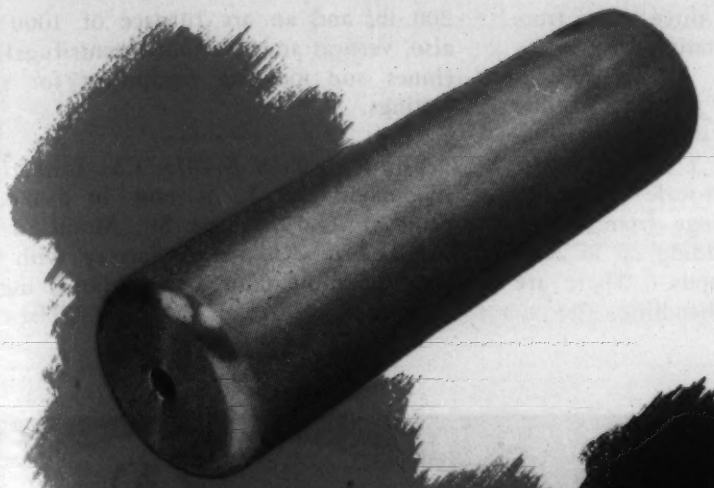
Electrical Pressure Switch

A new type of electrical pressure switch, with pressure ranges from five to 5000 lb., has been developed by the *Hercules Electric & Mfg. Co., Inc.*, 2416 Atlantic Ave., Brooklyn 33, N. Y.

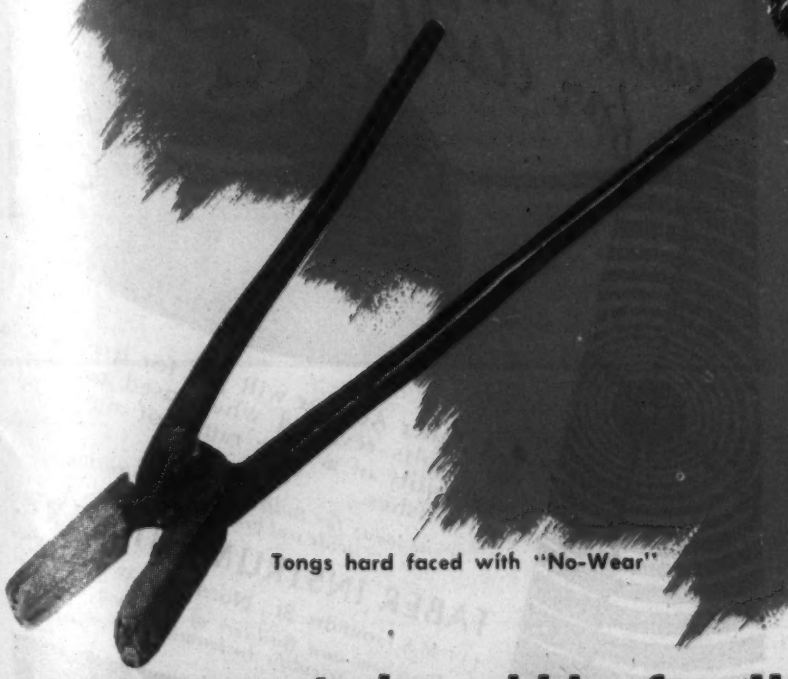
It is equipped with a direct action gage for hydraulic pressures operating a very sensitive electrical switch. Dimensions are 10 x 7 x 3 in.

● Welded pressure vessels are now offered by the *American Instrument Co.*, Silver Spring, Md., for high pressure use, particularly in research and pilot plant work. They are designed for storage of compressed gases at pressures of 6000 to 8000 p.s.i. Standard units are not intended for service at high or very low temperatures, nor for liquids in which solids may be present.

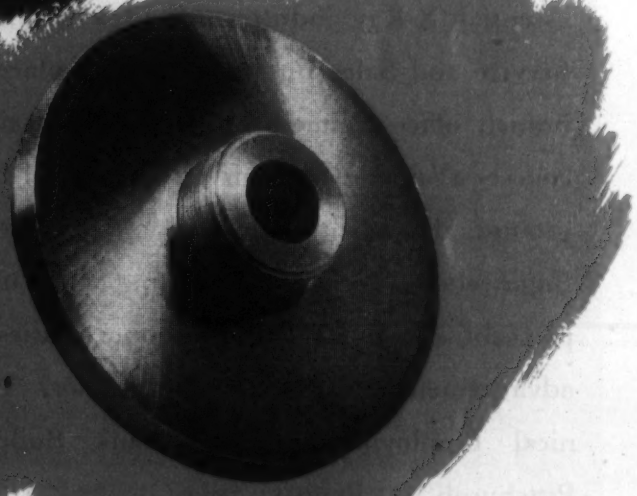
Callite "NO WEAR" METAL



"No-Wear" applied to grooved roll.



Tongs hard faced with "No-Wear"



"No-Wear" on die-pressed parts.

a cemented carbide for HARD FACING

Specialists in tungsten metallurgy for over 25 years, Callite developed "No-Wear" Metal to meet the demand for quicker, more economical hard facing. "No-Wear" greatly prolongs the life of parts and tools subject to severe abrasion and reclaims worn parts by re-surfacing. "No-Wear" is easily applied with the oxy-acetylene torch.

"No-Wear" applies readily in thin layers over base metals. It can be used on surfaces previously hard-faced. "No-Wear" Metal is extremely resistant to abrasive wear at high temperatures. Ask our engineers about specific uses. Callite Tungsten Corporation, 546 Thirty-ninth Street, Union City, New Jersey. Branch Offices: Chicago, Cleveland.

Send for Bulletin No. 153

Callite "NO WEAR" METAL

LIVES UP TO ITS NAME

Rods 14" in length, 1/4" and 5/16" in diameter. Hardness: (Rockwell "C" Scale) 63-67 cast, 62-66 gas-welded. Melting Point: 1300°C (2372°F). 1 lb. covers about 90 sq. in. 1/32" thick.

News of Men, Societies, Meetings and Companies

Plants and Slants

The *Reynolds Mining Corp.* has been granted a concession by the Haitian Government to mine bauxite and other aluminum ores on that island. This ore is destined to supply the Reynolds plant at Listerhill, Ala., the only one in the world that carries on the whole range of production from bauxite to finished sheet and rod. The Haitian ore has an extremely low silica content. It is called "Lescotite" in honor of the president of Haiti. The rich deposit is only three miles from the sea, making transportation easy.

The *American Brake Shoe Co.* has started operations in its experimental foundry at Mahwah, N. J. It is not a pilot plant, but full-scale foundry-designed to handle castings from a few pounds by investment molding up to 2000 lb. by conventional methods. There are five induction furnaces handling 100 to 200 lb. and an arc furnace of 1000 lb.; also, vertical and horizontal centrifugal machines and molding equipment for static castings.

The *Roos Tool & Mfg. Co.*, formerly of Bloomfield, N. J., is now in a modern plant at 17-19 Grove St., Montclair, N. J. The new two-story factory with 11,000 sq. ft. of floor space adjoins the D. L. & W. terminal in Montclair. The com-

PERMANENT POSITIONS

Available with national manufacturer in essential X-Ray industry. Experienced Field Service and Sales Engineers will be placed in branch offices immediately. Factory training courses available for man with technical background. Excellent opportunity for Electrical Engineers. Work is interesting and under pleasant conditions. Ample opportunities for advancement. Write the Supervisor, Technical Employment, Union Bank Building, Pittsburgh 22, Pennsylvania.

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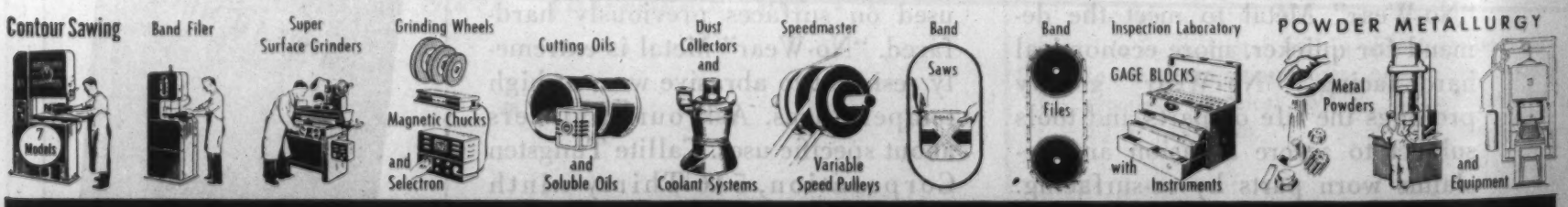

DoALL INDUSTRY'S NEW SET OF TOOLS

Write for Literature mentioning products in which you are interested
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FROM: Dr. Walter R. Meyer, Technical Director
The Enthone Co., New Haven, Conn.

SUBJECT: Corrosion Protecting and Blackening
Copper and Copper Alloys

TO: ~~Works Manager~~ K.L.D.
~~Design Engineer~~ A.H.W.
Finishing Chemist
Plating Superintendent
Methods Engineer

Prior to the development of Ebonol "C" for blackening and protecting copper and its alloys, there were three methods of blackening copper alloys in general use. These methods were sulphide blackening, black nickel plating and copper carbonate-ammonia blackening. Sulphide blackening is only effective on pure copper and very high copper alloys and is accomplished by immersion of the copper in dilute sulphide or polysulphide solutions one or more times, often with wire brushing in between dipping operations. The copper sulphide coatings thus formed possess poor mechanical qualities and are unstable chemically. They have poor ductility and are easily rubbed off mechanically. They evolve sulphide fumes at relatively low temperatures and tend to decompose easily. Perhaps a characteristic worse than these is the very poor corrosion resistance of sulphide films. Sulphide treated copper and copper alloys usually corrode when exposed to weather faster than the untreated metal.

Black nickel plating involves the deposition of a complex mixture by electroplating, of zinc, nickel, sulphur, carbon and ammonia. The coatings are usually thin (0.00005" to 0.0001") because heavier coatings are brittle. Black nickel is not jet black but gray, it is deposited slowly, it offers poor protection to the base metal and it can flake. It is a very poor base for baking enamels because it evolves ammonia rapidly when heated above 360°F. Lastly, black nickel plating requires careful control for successful operation and copper is not a good base for black nickel.

The copper carbonate ammonia process is only suitable for brasses ranging from 64 to 80% copper and deposits are poor on high copper alloys. Thin films of cupric oxide are formed by immersion in slightly ammoniacal basic copper solutions. The deposit is colored blue-black and possesses mild abrasion resistance. However, the coatings give little protection to the base copper (about 2 hours in salt spray) and are poorly absorptive, being smooth and shiny.

The development of the Ebonol "C" process early in 1942 gave the industry a method of treating copper and copper alloys that had none of the disadvantages outlined for sulphide blackening, black nickel, and the copper carbonate ammonia process. Copper alloys with from 70 to 100% copper can be blackened in about 10 minutes at 210°F. The coatings are deep black, adherent, have excellent heat stability and protect the base copper against corrosion. The coatings are dull velvet and are very absorptive. Because of this, oiled coatings withstand up to 200 hours in salt spray. The coating is also an excellent base for painting, enameling or lacquering and is similar to phosphate treatments for steel in this respect. Shiny coatings are obtained by oiling, waxing or lacquering.

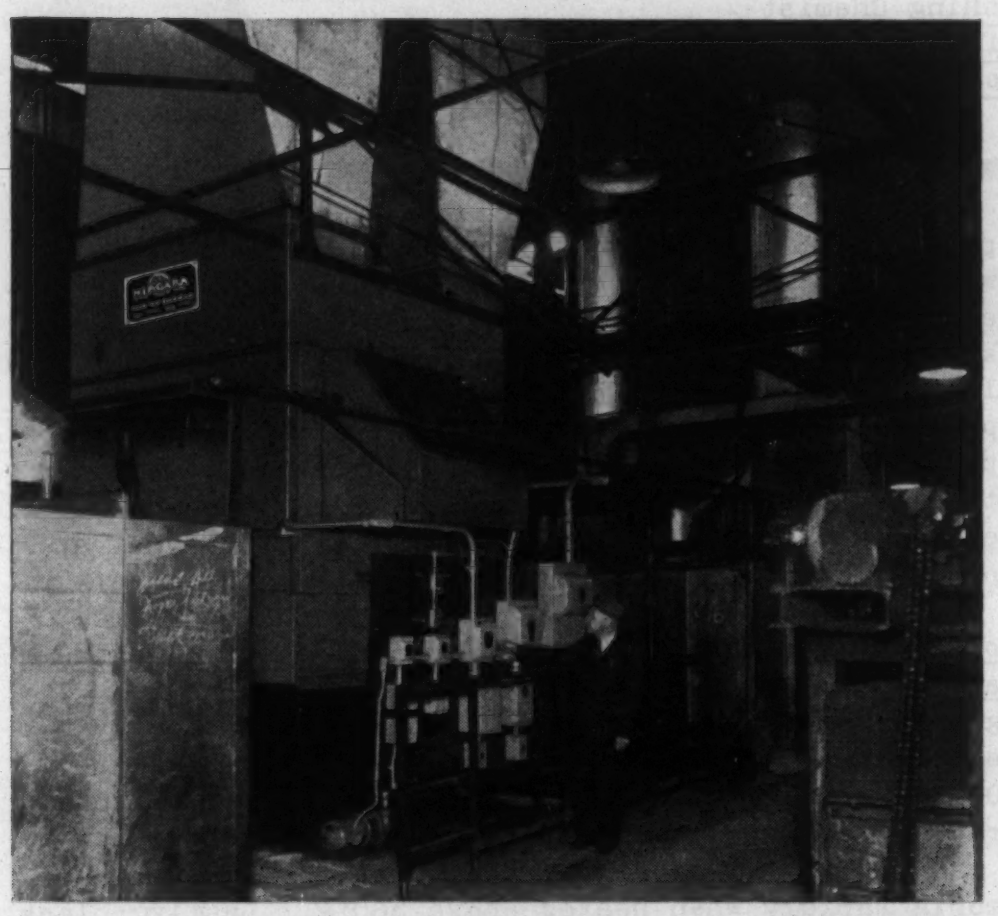
Low copper alloys and other metals can be blackened and protected by copper plating and then Ebonol "C" treating. The simplicity of this blackening procedure and the better characteristics obtained have resulted and are resulting daily in the substitution of Ebonol "C" for black nickel plating and other blackening processes.

Hundreds of war plants have adopted Ebonol "C" where quality and utility are important, and post-war industry will do this for quality, utility and beauty.

If you are doing war work and writing war specifications or are planning for post-war products, you should know about Ebonol "C". Literature and data are available as well as samples for your tests.

Better TEMPERATURE CONTROL of QUENCHING...

Increases Production - Reduces Rejects Improves Physical Properties



● Both large and small forgings and other heat-treated parts show improved physical properties and fewer rejections as a result of more exact control of quenching temperatures.

This is accomplished most successfully by the "Balanced Wet Bulb" Control, an exclusive feature of the NIAGARA *AERO* HEAT EXCHANGER, which also provides the constant reliable capacity, not dependent on water supply, to increase production. At the same time, because air is the cooling medium, water consumption and costs are cut 95%. Installation costs are economical because the NIAGARA *AERO* HEAT EXCHANGER does the work of both cooling tower and shell-and-tube heat exchanger. We eliminate much complicated piping and pumping.

These results are proven in hundreds of plants where the requirement for high physical properties after heat-treating has been combined with an urgent need for increased production. Write for a description of operating details and records of performance.

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pany makes wire drawing die machinery, lapping machines, drillers, grinders and polishing lathes.

A new one-story addition to the plant of the *Kelley-Koett Mfg. Co.*, Covington, Ky. has been completed.

Willey's Carbide Tool Co. is now occupying their new addition at 1340 W. Vernor Highway, Detroit. This new addition more than triples the original size of their plant.

The *Pennsylvania Salt Mfg. Co.* has moved its New York office to 40 W. 40th St., New York 18.

Less than six months after the original plant went into production on tungsten products, *Sylvania Electric Products, Inc.*, Towanda, Pa., announced that work on a $100,000 addition would begin immediately. The new building will have 19,000 sq. ft., of which 5,000 will be used for offices, the rest manufacturing.

Western Electric has leased Area 2 of the Eau Claire Ordnance plant at Eau Claire, Wis.

Buick Div., General Motors Corps., is tooling to manufacture a new high priority cargo plane engine of the Pratt & Whitney Twin Row Wasp type. About 50% of fabrication will take place in the Buick Flint plants, final assembly and testing taking place in the Melrose Park plant.

Meehanite Metal Corp., New Rochelle, N. Y., has granted manufacturing rights for Meehanite castings to the *Indian Hume Pipe Co.*, of Wadala, Bombay, India. W. H. Moore has been appointed technical manager of Meehanite in India.

Assets of *Wheelco Instruments Co.*, 847 W. Harrison St., Chicago, have been purchased by Fred A. Hansen and Cary H. Stevenson, vice presidents of the *Lindberg Engineering Co.*, Chicago, and several associates. The new company will expand further into other industrial applications of electronics and supersonics.

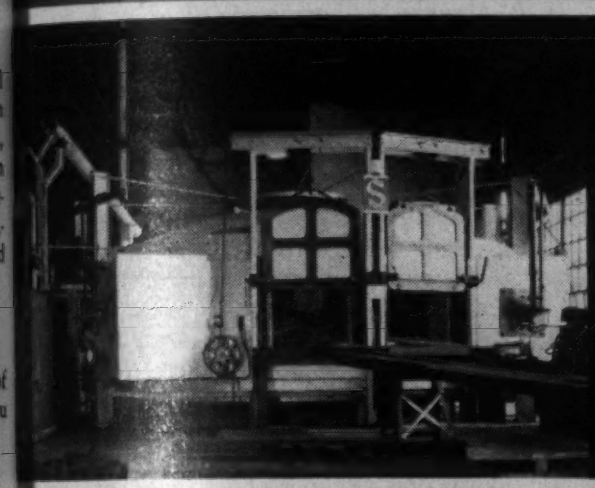
News of Engineers

Edward A. Kreller has been appointed manager of the cast to shape department of the Jessop Steel Co., Washington, Pa. A member of the American Foundrymen's Assn., he has had wide experience in cast to shape tool steels since he served 21 yr. with the Detroit Alloy Steel Co., where he started after the close of the first World War. For the last nine years

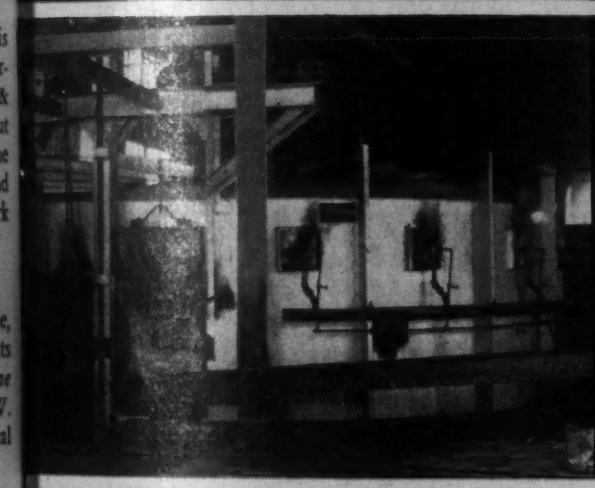
(Continued on page 1034)

Make Your Conversion For Postwar Operations Less Troublesome By Contracting Now For a Versatile SALEM ROTARY HEARTH FURNACE

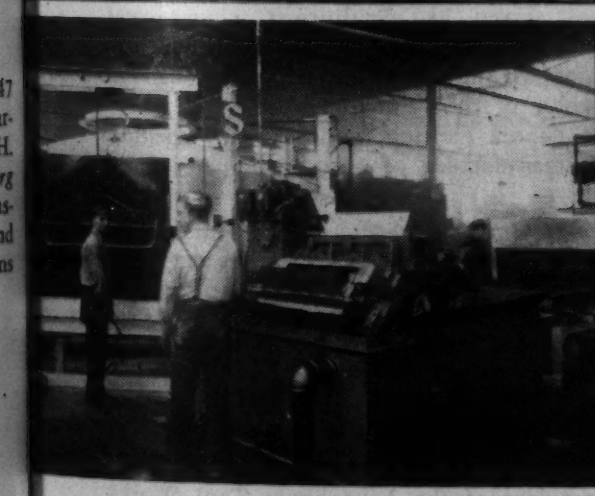
A Salem Rotary Hearth Furnace of this type gives you the advantage of very close control of the rate of heating and atmosphere. It is used to heat treat high carbon and alloy steels.



Splice bar plates receive heat treatment at 1750° F. but the furnace can operate up to 2000° if necessary. This Salem Rotary is a more economical and faster method than with the usual pusher type furnace.



This furnace heats shell forgings to 1500° F. for the hardening quench. The furnace temperature is then lowered to 1250° F. for the drawing operation. Special hearth construction cradles the shells as hearth rotates.



Hardening coil springs, this Salem Rotary operates at 1500° F. The bar stock is first heated in a roll down furnace, then the coils move into the Salem Rotary Furnace.

★

● When the time comes to switch from war production, you will appreciate the ease with which a Salem Rotary Hearth Furnace can be adapted to a change-over.

By adding a Salem Rotary to your production line *now,* you will be in a position to process your new postwar products quickly when the green light flashes for the "go-ahead."

Salem builds all sizes of Rotary Hearth Furnaces, small, medium, or large. For instance, in 1942, we installed the world's largest rotary heat treating furnace (2100 sq. ft. of hearth area) and on this page, we illustrate several smaller size Salem Rotary installations.

★

Get These Four Advantages

1. The Salem Rotary Hearth is self-emptying as compared to the pusher type.
2. The small openings in the Salem Rotary Hearth Furnace save fuel over a batch type.
3. With the Salem Rotary Hearth, the material is always moving. It never gets a chance to rest for more than a few seconds under a direct flame.
4. The Salem Rotary Hearth provides ideal loading and heating conditions.

SALEM ENGINEERING COMPANY:
Makers of All Types of Industrial Furnaces; Walk-in or Automatic Type Locker Plants; Refrigeration and Air Conditioning Systems

SALEM ENGINEERING COMPANY

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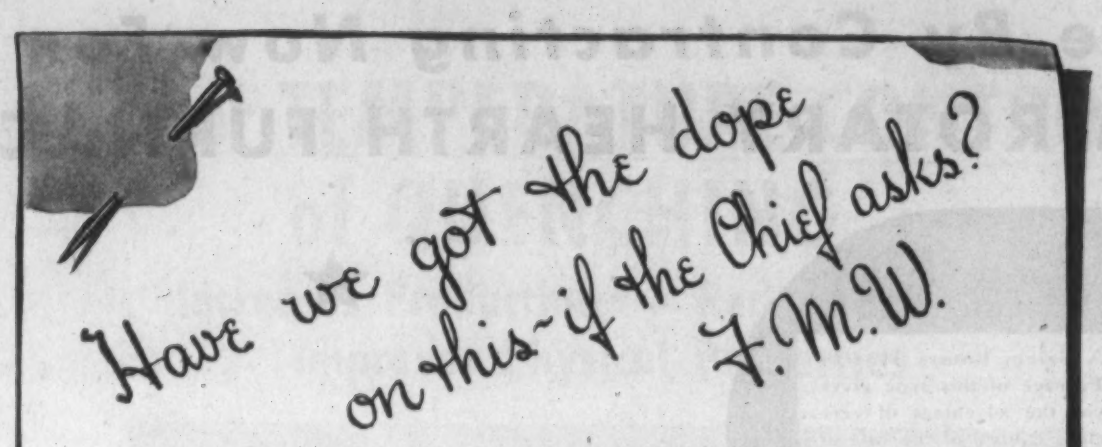

Where plant operations are controlled by air operated instruments . . . where processes involve moisture removal from liquids, gases or solids . . . KSG Silica Gel Dryers can be used to advantage. They are available in a wide range of types for either continuous or intermittent operation and are meeting requirements of 20 cfm to 100,000 cfm at dew points as low as −60° F.

For descriptive bulletins, specific information or engineering assistance, address The C. M. Kemp Mfg. Co., 405 East Oliver Street, Baltimore-2, Md.

ARMY E NAVY

KEMP of BALTIMORE

he was works manager of that organization.

Arthur Logozzo has been appointed technical service engineer for MacDermid, Inc., Waterbury, Conn., makers of metal cleaners and distributors of cleaning, plating and finishing equipment. He is an authority on hard chromium plating, and has addressed technical societies on the subject. He has won prizes and awards, and has written many articles for the technical press.

Anton Erhardt has been appointed plant superintendent of the National Tool Co., Cleveland, in full charge of its production of precision metal-cutting tools. He is an outstanding expert on grinding practice, and the inventor of an improved herringbone gear-shaped cutter that is widely used.

H. P. Munger has been made plant manager at Olean, N. Y., of two of the plants of the Van der Horst Corp. of America, which processes cylinders of internal combustion engines with a special porous chromium to extend their life markedly. Previously he was superintendent of the new electrotinning plant of Republic Steel at Niles, Ohio. At one time he was in research work with American Rolling Mills.

Dr. Scott W. Smith, physicist with the Kelley-Koett Mfg. Co., Covington, Ky., maker of X-ray equipment, has been appointed to a special committee formed by the War Metallurgy Committee, and will devise fluoroscopic methods of inspection of metallic materials.

Howard C. Renken has joined the research staff of Battelle Memorial Institute, Columbus 1, and has been assigned to its division of mineral dressing research. For several years he was with the American Smelting & Refining Co., but more recently with the Stauffer Chemical Co., San Francisco.

Herbert A. Reece has been elected first vice president in charge of operations of the Meehanite Metal Corp., New Rochelle, N. Y. He joined Meehanite in 1929, and has served as metallurgist, chief metallurgist, assistant to the president and manager of the corporation. He is an inventor of the "Equalized-Velocity" process of cupola melting, and of many methods of manufacture of specific property irons.

Dr. John M. Schweng has joined Turco Products, Inc., Los Angeles 54, as a chemical research engineer and director of bacteriological research. Among past accomplishments were the development of protective coatings for aluminum and magnesium alloys.

David A. Coleman has been made vice president of the Lake Shore Tool Works, Inc., 816 N. Kostner Ave., Chicago, maker of high-speed and carbide production tools.

Dr. Ora S. Duffendack, professor of physics at the University of Michigan, has been made director of research of North American Philips Co., Inc., among whose

Get this new aid

THAT HELPS IDENTIFY WELDING TROUBLES

New trainees learn to spot faulty welding procedures faster...“old hands” can increase their efficiency...with the help of this new 24-page book. By stressing accurate visual inspection, it helps boost both weld quality and quantity.

Each of the 14 most common welding troubles is illustrated with a typical “good” and “bad” example; causes are analyzed; and specific suggestions for cure are outlined.

The book is pocket-size—ideal for plant distribution. Welders can take it home to read or keep it handy on the job.

It's a helpful trouble shooter for problems like splatter, corrosion, undercutting and brittle joints. Order a copy of this booklet for each of your welders today.

This same information is also made available by Westinghouse in chart form for wall mounting. Write for free copies of booklet B-3326 and chart DC-250 on your company letterhead. Please state exact quantities required. Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., Dept. 7-N. J-90497-1

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EF FURNACES

For Every Industrial Heat Treating Process

Some EF Production Furnaces Engineered to Fit the Job

Roller Rail Pusher Furnaces

For annealing, heat treating, short cycle malleablizing, etc.

Used for handling miscellaneous products. The material is carried through the furnace in light baskets or trays. 40,000 pounds of malleable castings per day are annealed scale free in the above special atmosphere furnaces.

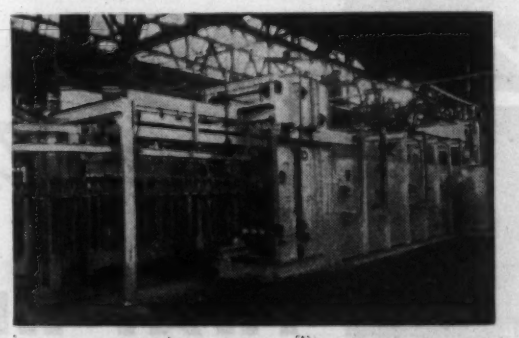
Chain Belt Conveyor Furnaces

For continuous heat treating small and medium sized products

For scale free hardening bolts, gears, bearing parts, springs, and miscellaneous other products in quantities. Material is loaded directly on belt, carried through the furnace and automatically quenched or otherwise discharged.

Suspended Conveyor Furnaces

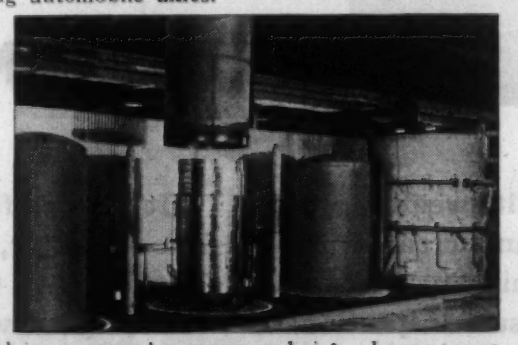
For handling various products and processes



For continuous heat treating metal parts, glass, vitreous enameling, etc. The work is suspended on hooks and carried through the equipment. The above installation is a continuous unit for hardening, drawing, and automatic quenching automobile axles.

Bell or Hood Type Furnaces

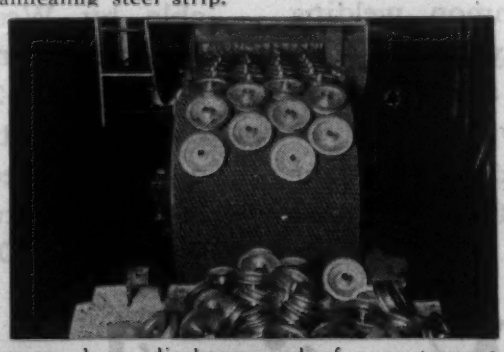
For annealing wire, strip, nitriding, etc.



Charges are placed on fixed bases, furnace is placed in position by crane or hoist. Inner cover contains protective atmosphere. May have forced convection to promote speed of heating or temperature distribution. This installation is bright annealing steel strip.

Mesh Belt Conveyor Furnaces

For copper brazing, drawing, etc.



Material is loaded directly on belt. Above illustration shows discharge end of a continuous furnace copper brazing fan pulley assemblies. The completed unit is discharged securely joined, clean, and bright.

We Specialize on Building Production Furnaces

The Electric Furnace Co., Salem, Ohio

Gas Fired, Oil Fired and Electric Furnaces---For Any Process, Product or Production

products are electronic tubes, fine wire, tungsten and molybdenum wire and rod.

Frank J. Stanley has been made plant manager of the Lebanon Steel Foundry, Lebanon, Pa. He has had 25 years' experience in operating steel foundries.

House Organ Notes

Steel Horizons. Allegheny Ludlum Steel Corp., Vol. 6, No. 1.

This glamor publication, 11 by 13¾ in., starts out with a Southwest Pacific anecdote. "Japs would wait until Americans had fired five shots and then rush the foxhole, thinking the Yanks were shooting the five-round Springfield rifle. It was a fatal mistake, for our men had three more shots in their Garand eight-round clip. Those three extra bullets usually took care of the situation." The leading article deals with rifle clips and disintegrating metallic-link belts for machine guns and cannon. "New gun turrets must have a fire flow of almost serpentine uncoiling smoothness, such as provided by 90° flexible 20-mm. links." The flexible M-2, newest .50 caliber links, are made of 0.65 carbon steel, 0.041 in. thick, plus or minus two. There are three operation methods. Punch presses are used in two of these, employing either the original seven-station progressive die, or the later-developed four-station die.

War Production Drive by Summerill. Summerill Tubing Co., Feb. 1, 1944.

Manufacture of X-ray apparatus suitable for use in the battle area presented problems. One involved the housing, which had to be light and strong. Aluminum was used at first, but later Summerill steel tubing was used, being two lb. lighter, and strong. The steel was less porous. The tubing was produced to copy exactly the aluminum casting it replaced. The tubing had to be flared, expanded, contracted, brazed, knurled, and welded. The thinnest part of the wall is but 0.035 in. thick.

Pig Iron Rough Notes. Sloss Sheffield Steel & Iron Co., Winter, 1944.

An off-the-regular-routine bit of information involves the photo enlarging machines of the Army and Navy. Reconnaissance pictures are part of "the eyes" of our Armed Forces. The base of the enlarging machine is a casting made by the Noblesville Castings Co., Noblesville, Ind., "Sloss" pig iron being the raw material.

Amsco Bulletin. American Manganese Steel Div., American Brake Shoe Co., No. 1, Vol. 15, 1944.

With photographs and captions are depicted typical parts of the typical airplane in which the company's manganese steel enters. These are: Bearing blocks, propeller hubs, tail skid shoes, shafts for ailerons,

Puts TANK STRENGTH into STEEL REPLACEMENT PARTS

In army tanks, there are wearing parts made of Nitrided Nitralloy operating against each other without lubrication, in sand, moist atmosphere and heat. Nitrided Nitralloy puts these tank-tough qualities to work in your steel replacement parts, enabling them to survive overloads, saving repair time on vital equipment. Due to their unequalled hardness and long life, Nitrided Nitralloy maintenance parts are helping sustain heavy operations, increasing output in hundreds of critical industries.

If you design your metal parts for maximum life, use Nitrided Nitralloy. Its sapphire hardness and freedom from internal stress, combined with a minimum of distortion during nitriding, make it a life saver for operating men. To aid you in applying nitrided steels to best advantage, send for any of these booklets: "Nitralloy and the Nitriding Process," "Hardness," "Fatigue of Metals." In writing, kindly use your business stationery and title.

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Crucible Steel Co. of America New York, N. Y.
Firth-Sterling Steel Co. McKeesport, Pa.
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The Timken Roller Bearing Co. Canton, O.
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Met-Lab, Inc. Philadelphia, Pa.
New England Metallurgical Corp. Boston, Mass.
Pittsburgh Commercial Heat Treating Co. Pittsburgh, Pa.
The Salkover Metal Processing Co., Inc. Long Island City, N. Y.
Queen City Steel Treating Co. Cincinnati, O.
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Wesley Steel Treating Co. Milwaukee, Wis.
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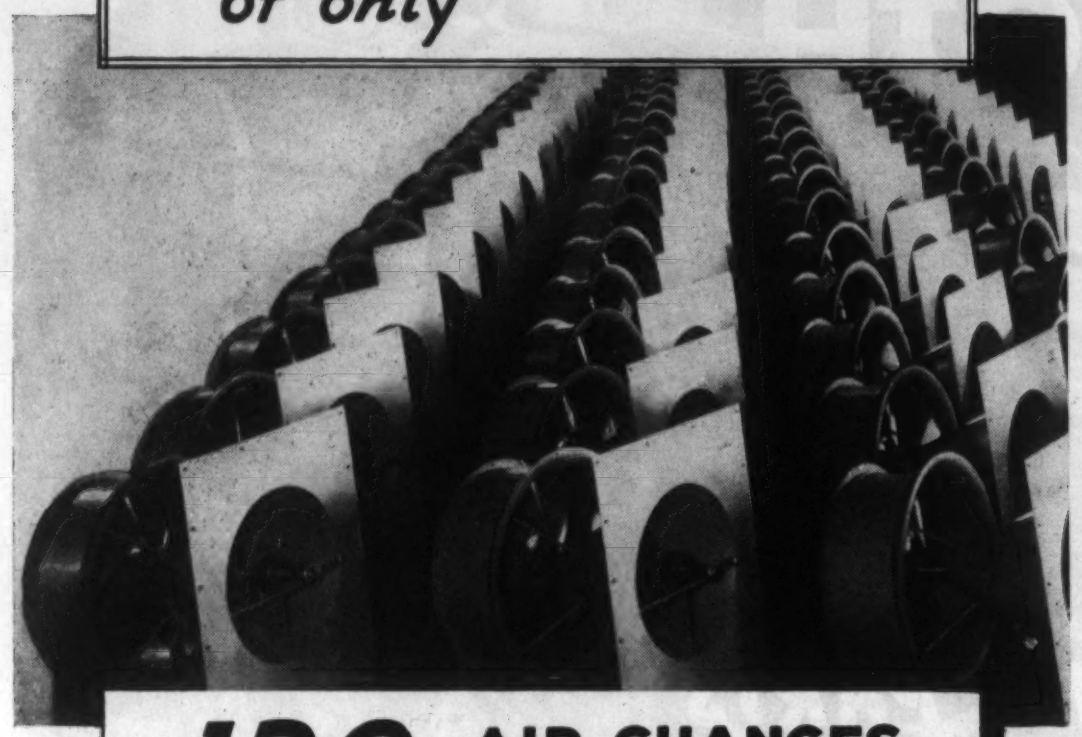
Ontario Research Foundation Toronto, Ontario, Canada

Manufacturer of Nitralloy Steel Castings

Milwaukee Steel Foundry Div., Grede Foundries, Inc. Milwaukee, Wis.

Temperature Difference of only ±2°F



120 AIR CHANGES *PER MINUTE* IN THE NEW ROSS HEAT TREAT OVEN *For TUBE TURNS, INC.*

One reason for the small temperature difference of ±2°F. obtained in the ROSS Automatic Heat Treat Ovens for Magnesium and Aluminum is the use of enormous volumes of properly distributed air.

The above photograph shows the specially designed STURTEVANT high temperature Axiflow Fans assembled for shipment to TUBE TURNS, INC., where they were used on a battery of ROSS Ovens for heat treating aluminum forgings.

OTHER USERS OF ROSS HEAT TREAT and AGING OVENS INCLUDE:

Chevrolet Motor Company

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National Aluminum Cylinder Head Co.

Pratt & Whitney Aircraft Corporation

Packard Motor Company

Reynolds Metals Company

Wright Aeronautical Corp., and many others.

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piston rings, control sticks, compressor crankshafts, cam bearings, turtle back struts, brake linings, bomber parts, cylinder barrels, crankshaft gears, tail wheel mast hubs, and engine mount brackets.

The Alloy Pot. New Jersey Zinc Co., Feb. 1944.

A novel feature is the "Post-War Planners' Page," and a leading topic here is "Interchangeability — A Factor in Product Design." "The use of zinc alloy die castings provides dimensional accuracy which not only insures a snug-fitting assembly of mating parts but also eliminates service problems in the field through the exact fit of replacement parts."

Lead. Lead Industries Assn., Jan.-Feb. 1944.

During World War I it took hours to remove grease from a new gun before it was ready for use. Now the .50 caliber machine gun is packed in a plastic envelope. A lead ring, crimped over the ends of the envelope, provides an air and vapor tight seal.

Ampcometal. Ampco Metal, Inc., Feb. 15, 1944.

"Back in 1915 Ampco was a 'secret metal.' The chemical composition was decidedly hush hush. There was no reference to aluminum and iron content. It was 'a bronze of at least 80% copper.' The secret was safely sealed and deposited in a safety deposit vault. Only three men in the company knew the secret. Today the chemical composition is widely known, while catalogs and bulletins boldly list the principal ingredients."

Welding Briefs. Metal & Thermit Corp., Jan.-Feb. 1944.

Interesting war manufacture involves spherical anti-submarine net floats, 50 in. in diam. They are built up of six segments of 3/16-in. steel plate, die-cut from flat rolled sheets, and shaped on a forming press. Reinforcing plates and mooring lugs are welded to top and bottom segments. Four side segments are attached to the bottom plate by tack welds on the insides. The top section is tack welded from the outside. The entire assembly now goes to the positioner, welds being made from the outside only, using ¼-in. Murex Fillex electrodes at fairly high currents. These floats have withstood salt water submergence tests to a depth of 250 ft.

Briefs on Associations, Promotions, Education

Junius D. Edwards, assistant director of research, Aluminum Co. of America, has received the annual award of the Pittsburgh section, American Chemical Society, in the form of an aluminum plaque. The citation reads: "In recognition of his distinguished service to chemistry, through his fundamental contributions in the fields of gas chemistry, aluminum and aluminum paint, and the practical application of these developments for the betterment of mankind through his activities as inventor, author and editor."

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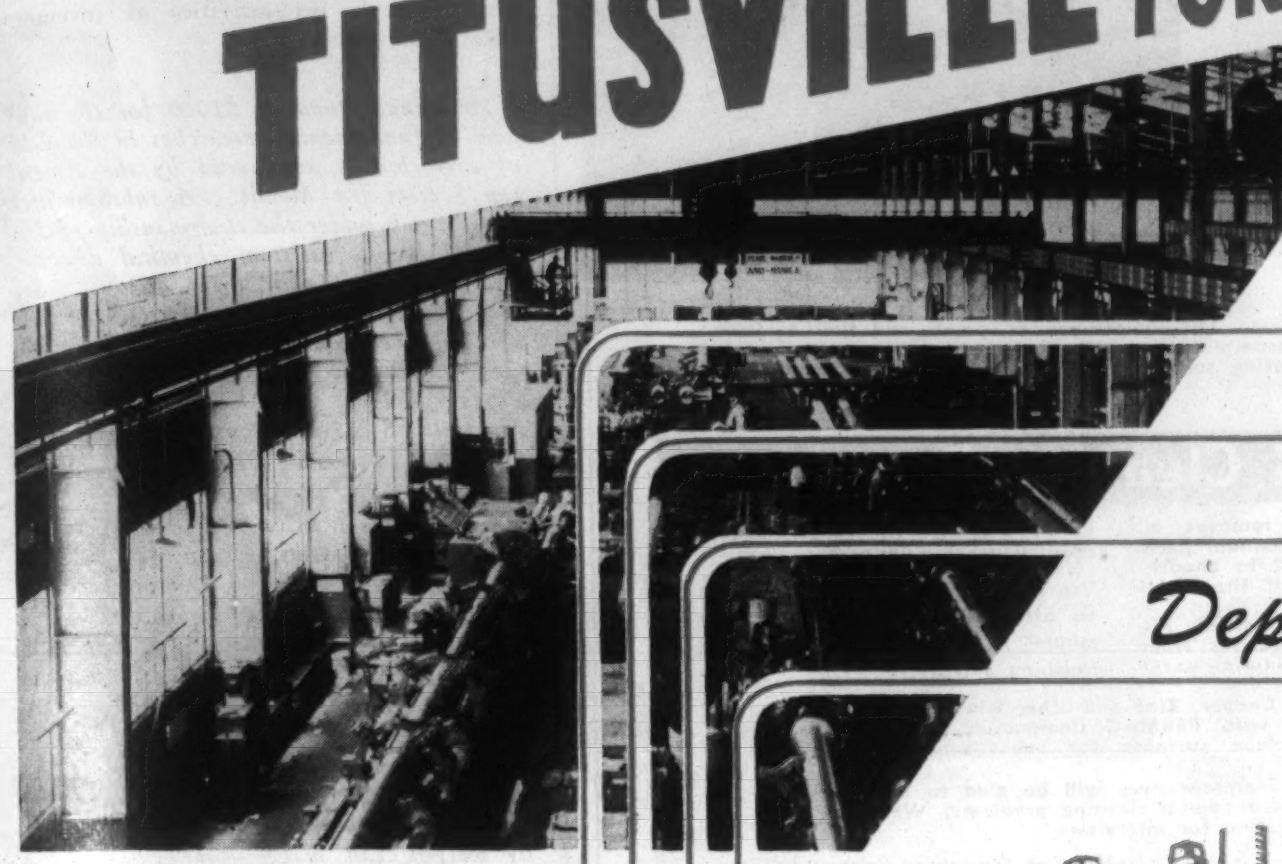

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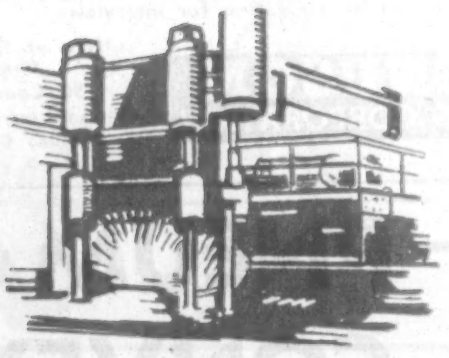

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distinguished service to chemistry, through his fundamental contributions in the fields of gas chemistry, aluminum and aluminum paint, and the practical application of these developments for the betterment of mankind through his activities as inventor, author and editor."

An annual fund of $1000 for the support of fundamental researches in the field of corrosion is announced by the American Society for Metals. A subcommittee on research under the chairmanship of Dr. R. M. Burns, assistant chemical director, Bell Telephone Laboratories, 463 West St., New York, has been named. Other members of the committee are T. S. Fuller, General Electric Co.; Dr. F. W. Adams, Pittsburgh Plate Glass Co.; and Dr. H. L. Maxwell, E. I. du Pont de Nemours & Co., Inc. experiment station.

An exhibition of war products made in the city of Dayton, Ohio, was held in the Engineers' Club of Dayton recently. Production of 40 plants was featured. Some very complicated products were displayed, such as a 30,000 r.p.m. gyroscope, and precision production gages utilizing air, light and lever measurement.

Tiny amounts of hydrogen in steel, as small as one two-thousandth of a per cent by weight, can make steel brittle, stated Dr. Herbert H. Uhlig, metallurgist, General Electric Co., before the American Institute of Mining & Metallurgical Engineers.

Five new Bureau of Mines instructional source films depicting some of the manufacturing processes used in the fabrication of aluminum and its alloys are ready for free public distribution. Those interested may apply to the Bureau at 4800 Forbes St., Pittsburgh 13.

Avoiding the cluttering of the minds of new women workers with unnecessary knowledge, the Lodge & Shipley Machine Tool Co., Cincinnati, has devised a streamlined, simple formula embracing a 4-point training plan of fundamentals for machine shop practice. Trainees learn the use of the 6-in. scale, how to read a decimal chart and mechanical drawings, and how to use a micrometer. Company officials claim that the program "builds morale, confidence and interest, and keeps absenteeism and turnover to a low level."

Widespread interest in heat treating is attested by Lindberg Engineering Co., Chicago, who have sponsored two sets of films on "Heat Treating Hints." A total of 97,763 persons have viewed these films; they have been shown 1,212 times in the two years since their release.

The highest honor conferrable by the American Institute of Mining & Metallurgical Engineers is that of honorary membership. Recently this honor was bestowed upon Selwyn G. Blaylock, president and managing director, Consolidated Mining & Smelting Co. of Canada, Ltd., Trail, B.C. The citation reads: "In recognition of his eminent standing as metal-

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The important factor in meeting post-war "cost-conscious" competition is to *speed production,* using less manpower and less fuel by eliminating all possible waste and wasteful operations. Hagan Rotary Hearth Forging Furnaces meet these requirements, supplying a continuous flow of uniformly heated billets.

LESS HEATING TIME

By spacing apart the billets vertically, the exposed heating surface is increased to 90%—as compared with 40% in the ordinary pusher-type furnace. This positioning increases exposed surface area up to 125%, which means higher quality forgings with reductions in heating time up to 40%.

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Lower operating temperatures and shorter time in the furnace result in material reduction of fuel consumption. Furnace temperatures need never exceed 2350°F. Time in furnace is reduced up to 40%. An actual operating comparison reveals a 58% reduction in fuel consumption as compared to open slot furnace operation.

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Lower furnace temperatures, less time in the furnace, constant temperature uniformity on from 80 to 90% of billet surface area, plus method of firing, reduces scaling and metal losses. Cold, burned or underheated steel is eliminated —every billet forges the same. One plant reports "forging over 30,000 pieces without a rejection." Meanwhile . . .

LOWER MAINTENANCE COSTS

are possible due to the Hagan patented hearth construction. The moving hearth rotates under the fixed wall and not inside the wall. Thus scale and debris cannot fall into the vertical clearance between the hearth and the wall.

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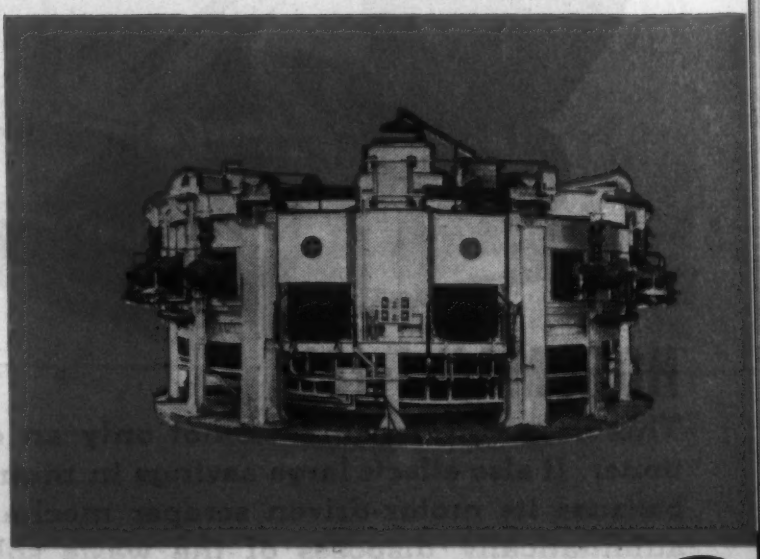
are setting new production records in America's leading forge plants—proof that Hagan Rotaries will play an equally important role in cutting *your* post-war production costs by producing a 100% *yield* between cold billets and finished salable forgings.



A Descriptive Bulletin will be sent on request.

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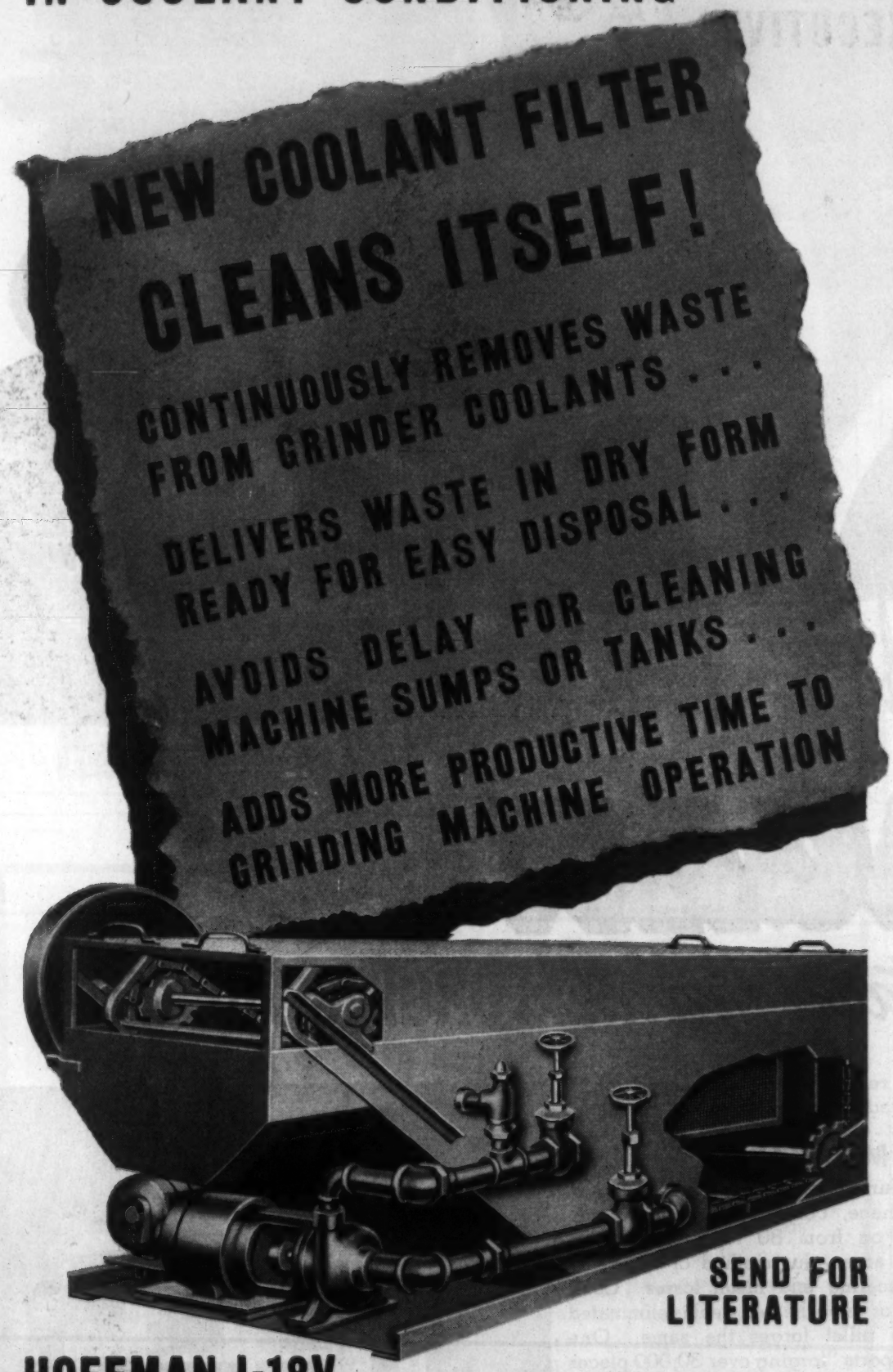
IMPORTANT NEWS
IN COOLANT CONDITIONING



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lurgist, engineer, and administrator of mining and metallurgical enterprises; and the effective and patriotic service he has rendered his country and the United Nations in critical times."

Because he overcame bottlenecks in metallic magnesium and calcium, Glen David Bagley has been awarded the Jacob F. Schoellkopf medal for 1944 by the Western New York section, American Chemical Society.

Meetings and Expositions

ELECTROCHEMICAL SOCIETY, spring convention. Milwaukee, Wis. April 12-15, 1944.

AMERICAN ZINC INSTITUTE, annual meeting. St. Louis, Mo. April 17-18, 1944.

AMERICAN INSTITUTE OF MINING & METALLURGICAL ENGINEERS, Open Hearth and Blast Furnace Conference. Pittsburgh, Pa. April 20-21, 1944.

AMERICAN FOUNDRYMEN'S ASSOCIATION, annual meeting and 3rd War Production Foundry Congress. Buffalo, N. Y. April 25-28, 1944.

INSTITUTE OF THE AERONAUTICAL SCIENCES, spring meeting. Detroit, Mich. April 27-28, 1944.

ASSOCIATION OF IRON & STEEL ENGINEERS, spring meeting. Pittsburgh, Pa. May 8, 1944.

AMERICAN INSTITUTE OF MINING & METALLURGICAL ENGINEERS, regional meeting. Houston, Texas. May 8-10, 1944.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, semi-annual meeting. Cleveland, Ohio. May 14-16, 1944.

SOCIETY OF AUTOMOTIVE ENGINEERS, Diesel, fuels and lubricants meeting. Chicago, Ill. May 17-18, 1944.

SOCIETY FOR EXPERIMENTAL STRESS ANALYSIS, spring meeting. Boston, Mass. May 18-20, 1944.

AMERICAN IRON AND STEEL INSTITUTE, general meeting. New York, N. Y. May 25, 1944.

SOCIETY OF AUTOMOTIVE ENGINEERS, war materiel meeting. Detroit, Mich. June 5-7, 1944.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, semi-annual meeting. Pittsburgh, Pa. June 19-22, 1944.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting. New York, N. Y. June 26-30, 1944.

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trends

By Edwin F. Cone

1300 Furnaces Making Steel

The extent of the growth of American steelmaking capacity, measured in number of steel melting furnaces, is afforded by a recent statement of the American Iron and Steel Institute. There are, it says, nearly 1000 open-hearth steel furnaces, ranging in size from small ones making only 10 tons of steel at a time to one huge furnace rated at 400 tons per heat, which have been producing steel for war. Besides these, steel is made in 185 electric arc furnaces, in 38 electric induction furnaces, 35 Bessemer converters, and 9 crucible furnaces.

Steel Publicity

The excellence of the publicity publications of various American organizations is expanding rapidly. One of the best examples of this is the work of this character of the American Iron and Steel Institute. Its *Steel Facts* and *Steel for Victory* have made a commendable reputation, but its recent *Weapons that Win* — or new war roles for American steel — is the culmination of a laudable and high-grade publicity undertaking.

Steel Output This Year

If the rate of steel production for the first two months of this year is maintained throughout the year, a new record will be hung up. Output of steel ingots and steel for castings for the first 2 months of this year at 14,783,684 net tons exceeds the 14,247,715 tons for the same period last year by 535,969 tons or 3.7%

More Steel Plate

A new record in the American production of steel plates was made in 1943. The total is put at 13,382,390 net tons. In 1942 the total was 11,800,000 tons, then a record. The insistent demand for more ships, intensified by the building of invasion craft, is responsible.

Lightweight Welded Freight Cars

"Welding, the ancient industrial process that has emerged as an essential construction method in war production, will be used extensively after the war to build lightweight box cars that will save up to 20% in weight and increase payloads accordingly," according to the prediction of W. N. Barker, vice president of the Pullman-Standard Car Mfg. Co. It will take, he said, many years to replace the railroads' 1,700,000 over-age heavyweight freight cars but such a program is expected to begin immediately on the arrival of peace.

Eighty Years of Steel Output

An impressive measure of the extent to which the American steel industry has expanded is afforded by some data recently published by the American Iron and Steel Institute in its February-March *Steel Facts*. Totals of actual steel production from the first year to the present time are given. In the first year, 1863, only 9044 net tons were made. The preliminary data for 1943, of 88,872,598 tons show that in 80 yr. the total has expanded 9840-fold.

Chief Steel Consumer Last Year

History has repeated itself — the shipbuilding industry ranked first in 1943 as the leading wartime consumer of steel — same as it was in 1942. Almost 11,433,000 tons of steel products were reported shipped last year from steel plants to the yards of naval and merchant vessel builders. This was 19.1% of the total steel shipments (59,760,443 tons) and compares with 9,440,000 tons delivered in 1942.

Shortage of Carbon Steel Scrap

The possibility of a shortage of carbon steel scrap for open-hearth furnaces is seen by E. C. Barringer, president and executive secretary of the Institute of Scrap Iron and Steel. A definite shortage is now apparent, he says, which is more likely to intensify than diminish for the duration of the war.

Gray Iron Castings

Some interesting statistics on gray iron, though late, have been made public by the WPB. For the first 11 months of 1943, the reports of about 2000 foundries out of a total of about 2214 domestic companies making gray iron show that they shipped 7,773,000 net tons of castings. The reporting companies represent a coverage of about 93% of the industry.

More Steel Castings in 1943

Data compiled by the Bureau of Census show that the output of steel castings for 1943 was substantially larger than in 1942. The 1943 total was 1,927,865 net tons as compared with 1,679,178 tons in 1942, an increase of 248,687 tons or nearly 15%. The 1941 production was considerably less at 1,316,027 tons.

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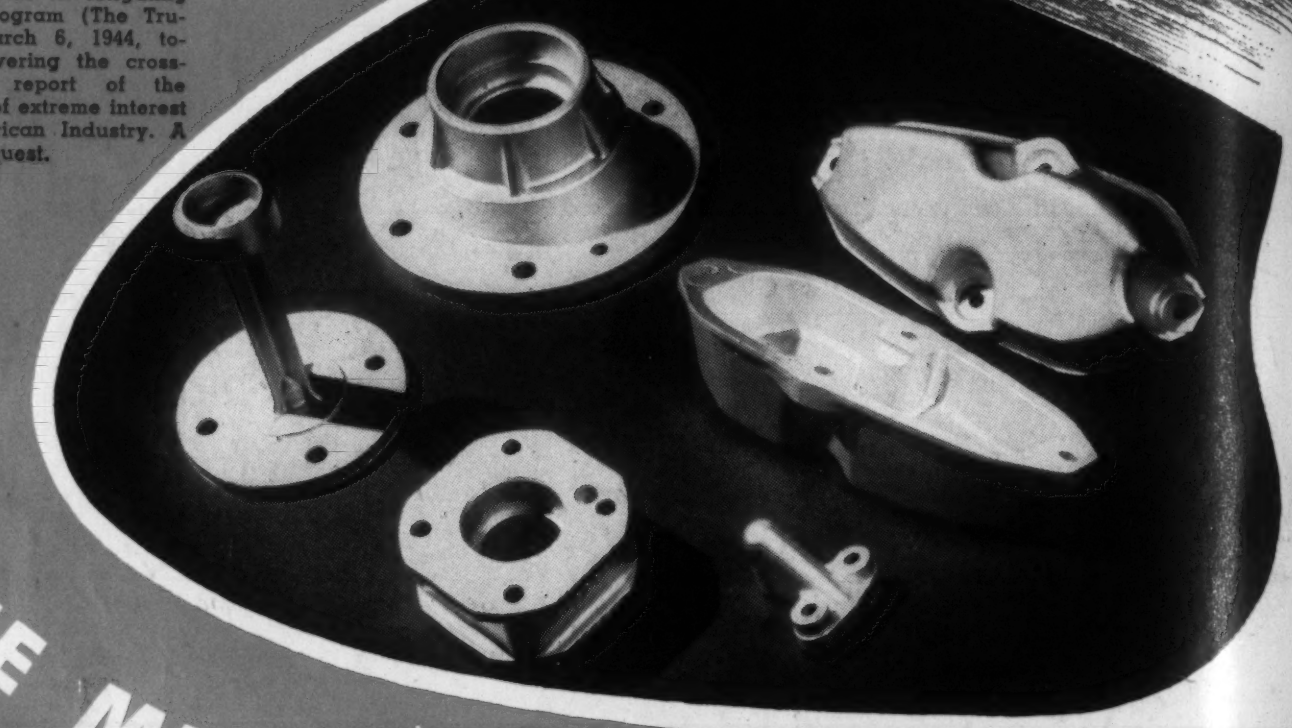
"Dow and Magnesium"—a booklet covering the statement filed by The Dow Chemical Company with the Special Committee of the U. S. Senate investigating the National Defense Program (The Truman Committee) on March 6, 1944, together with extracts covering the cross-examination and the report of the Committee. This book is of extreme interest and importance to American Industry. A copy will be sent on request.



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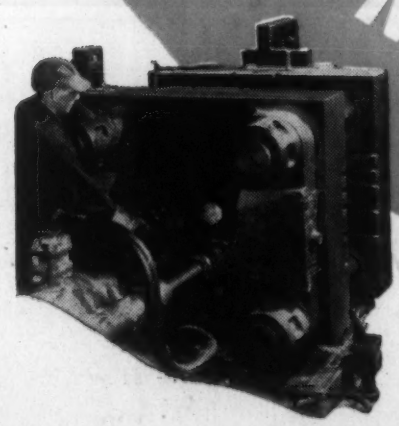

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